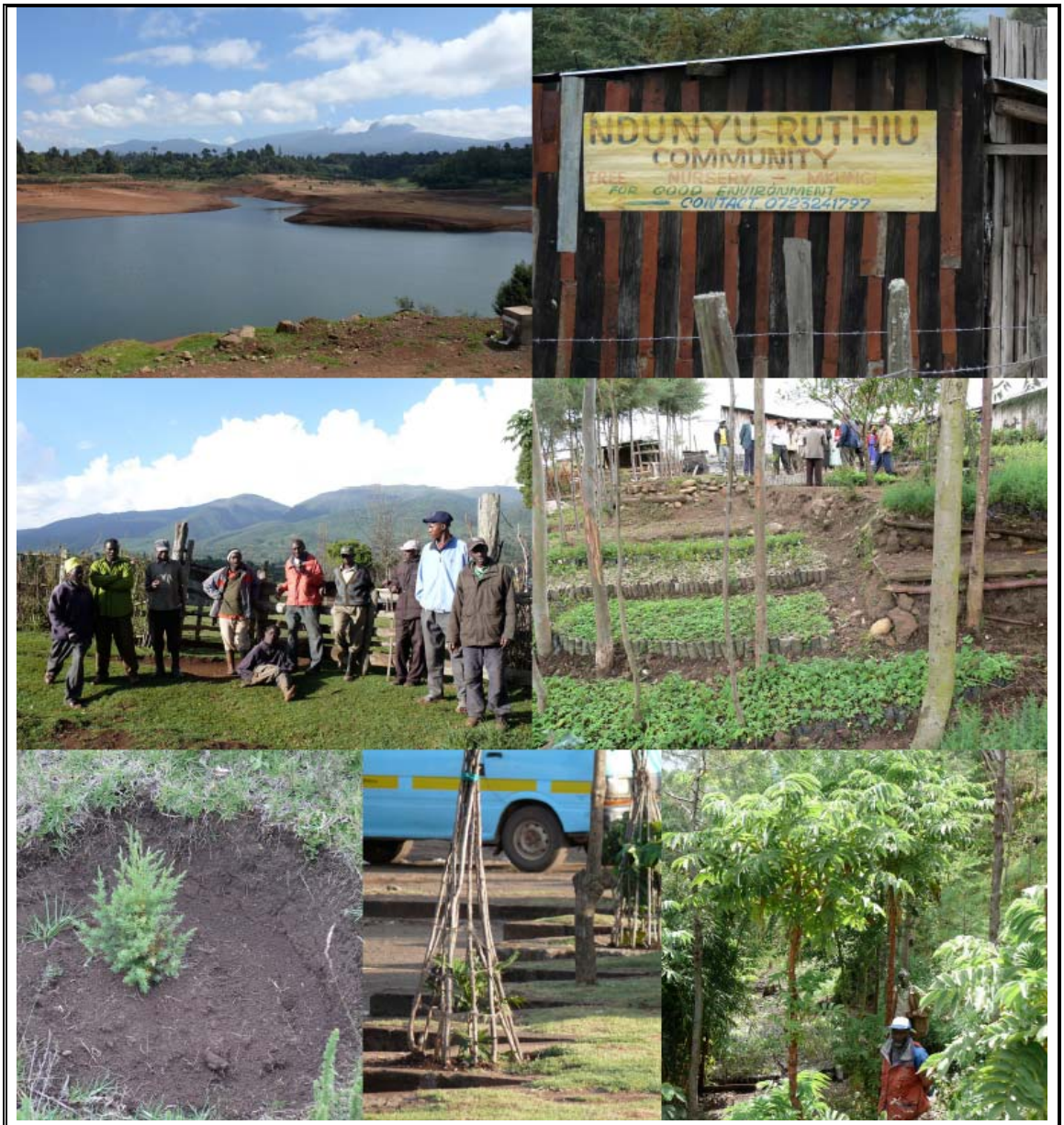
Rehabilitation of the Aberdare Forest Ecosystem

A Project implemented by the Green Belt Movement and supported by the French Agency for Development



A report of the Mid Term Review Mission

(CIRAD Consultancy Team, Nairobi, September, 17 - October 02, 2009)

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Executive Summary

1. The Mid Term Review of the *Rehabilitation of the Aberdare Forest Ecosystem Project* which is funded by AFD (Agence Française de Développement) and implemented by GBM (Green Belt Movement) was carried out from September 17th to October 2nd 2009 by 3 consultants: **Denis Depommier**, Agroforestry expert and Regional Director, CIRAD-Nairobi, **Munene Kabengi**, independent Development Consultant from Kenya, and **Dominique Louppe**, Senior Forestry Expert, CIRAD-Montpellier.

2. The main **objective of the review** was to formulate an independent and reasoned opinion on the Project, and specifically to: assess its progress towards its stated goals, assess the Project approach and methodology, identify constraints hindering such progress, provide recommendations for the remaining Project implementation period, and recommendations for a possible continuation / reorientation of the Project.

Part 1: Analysis of the context of the Project

- Kenya environment, rural development and management of natural resources.

3. Poverty, high population density, increasing needs for agricultural land, energy and building materials from wood in Central Kenya are the main causes of the degradation of the forests of the Aberdare range. As a result, close canopy forests of the country – including the Aberdare range- have regressed from 2.8% a century ago to 1.7% nowadays.

4. The new **Forest Act of 2005** brings a new community based approach in the management of the forests. Participation of local population, through associations (CFA) and forest management plans in which they have real interests and significant returns is the basis of an integrated and sustainable management of the forests.

5. Kenya has a **high biodiversity** that is an important source of livelihood, especially for poor people in rural areas who may have a strong traditional ecological knowledge of native species and their management – and notably make large use of non woody products such as medicinal products, wild honey and fruits.

6. Mountain forests which are referred to as **Kenya's five "water towers"** (of which the Aberdare Range,) can be used to delineate the upper watersheds of the major rivers which drain into the arid and semi-arid lands and are an indispensable source of water to grow crops, raise livestock, and support wildlife. They are also the main source of water and hydro-electricity for urban areas, particularly to Nairobi. The degradation of forests and other permanent ground covers of these water towers already had some dramatic consequences such as the drying up of many sources and the transformation of permanent rivers into temporary ones; so dams are running below their full capacities. Restoration of the tree cover in these water towers is a national priority. Fighting deforestation, illegal logging, overgrazing, etc. will not be possible without impacting on the local populations and their commitment. The Green Belt Movement 30 years of experience in tree planting in farmlands, its capacity to create awareness, and mobilize these populations are major assets to answer such a challenge.

7. **The Aberdare range** is situated in the heart of the Central Province and has been subjected to intensive tectonic disturbance and subsequent volcanic activity. It belongs as

well to the "Afromontane and Bamboo" bio geographic region. Climate is determined by altitude and wind exposition which affect rainfall. The highest annual rainfall is observed in the centre of the Aberdare range and on its Eastern and South Eastern slopes (P> 1500 mm/year) whereas the Southern and Western sides receive only 1000 to 1200 mm, even at high altitude (2500 m). Soils on the upper Eastern slopes of the mountain are of basaltic origin, dark reddish brown in colour, very deep, well drained clays which are naturally highly fertile (of alkaline nature). Soils on the Western side are more variable, being of medium to high fertility but interspersed with areas of lower fertility and poor drainage.

8. **Socio-economic traits:** More than 80% of the population of the Aberdare Region is rural.The population density is high: 278 inhabitants/km² 10 years ago, with densities of 450 to 550 in some districts and that may lie between 600 and 700 inhabitants/km² in 2009. The working force is composed of a majority of agriculturalists – Kikuyu for most of them. Maasai pastoralists and their livestock, seasonally occupy parts of Eastern side of the range such as the Kikuyu escarpment. The poverty line reaches 30 to 40% of that rural population.

9. Agro-ecological zones and land use in the Aberdare: Agriculture is the dominant land use: mixed farming (dairy cattle, food, and cash crops) characterizes this highly productive agricultural land, with large use of water from neighbouring forests.
Land use can be classified according to the following zones: 1- The National Park (76700 ha) well protected thanks to its total fencing, altitude 2500-4000 m, vegetation: sub-alpine and alpine moorlands, close-canopy forests, bamboo forests; 2- The Gazetted Forests: altitude 2000-2500 m : higher elevations include most of Kenya's densest and multilayered tree cover, but forests are locally much degraded; 3- The Tea-Dairy zone: altitude 1800- 2300 m, steep to very steep valley sides, high rainfall; tea which extended at the expenses of the forest, is dominated by small scale farmers, co-existing with big estates.

10. **Forests and tree plantations** in Aberdare cover about 148,000 ha and are part of the larger Aberdare forest ecosystem, including: the forest reserve (99,265 ha), the Kikuyu escarpment (36335 ha), and the Kipipiri Forest reserve (3900 ha) and the national park (76700 ha) – viz. a total of 216,200 ha; of which indigenous natural forests represent 36%, bamboo forests 33%, trees plantations 17%, grassland and bushland 14%.

11. **Forest threats and management in the Aberdare range**: The 2002 aerial survey carried out by UNEP shows an important level of destruction of the forest ecosystem surrounding the National Park by illegal activities such as charcoal production, tree logging, cultivation and overgrazing. But the electrical fences recently erected around the park should reduce the threats on it and allow the reconstitution of the natural resources, forest and water notably, Planting indigenous trees inside the fences should be a good opportunity to accelerate the reconstitution of the native forests (in 2006, the degraded forest to be rehabilitated in six initially targeted districts of the Project was estimated to 6,930 ha). The comparative aerial views (1987-2002) show also an extension of tree planting in farmlands.

12. Aberdare and wood production: Since the total ban on timber harvesting imposed in 1999, pressure on trees in farmlands and illegal cutting of wood continues irreparably in gazetted forests and plantations, whereas KFS plantations of exotic species in Gazetted areas could provide an important part of the timber production of the country.

- National legal frameworks:

13. **The 2005 Forests Act**, addresses national and global challenges: the management of non gazetted forests and the participation of local communities and other stakeholders in forest management. This new Participatory Forest Management (PFM) approach is to be applied through memorandum of understanding between Community Forest Association (CFA) and KFS and appropriate forest management plan. GBM, through its own networks, and natural links with CFA is involved in the preparation of certain PFM plans that have been designed for various areas including the Aberdare and developed with the local populations.

14. The **2002 Water Act** led notably to the separation of the management of water resources from the provision of water services (now under a Water Services Regulatory Board), and of water and sanitation from the management of water resources, the decentralization of functions to lower level state organs (7 regional Water Services Boards) and the involvement of non-government entities in the management of water resources as well as in the provision of water services. An autonomous Water Resources Management Authority (WARMA) was established aiming to manage and protect Kenya's water resources.

15. Land rights, land registration and land ownership in Kenya are complex. The **Agriculture Act**, besides its agricultural objectives, is to provide for the preservation of the soils and their fertility, including soil and water conservation measures; and restrictions on (tree) vegetation clearing and grazing in fragile ecosystems.

16. **Wildlife management** is not considered as a land use. But KWS, on behalf of the State has authority to manage it, and this authority extends to both protected and unprotected areas. Fencing of the parks or reserves reduces the conflicts between humans and wildlife; and Participatory Forest Management plans will better associate communities to wildlife and indigenous forests based activities such as eco-tourism.

- GBM vision and approach:

17. The **Green Belt Movement** is a community-based NGO focussing on environmental conservation, community empowerment and capacity building; funded in 1977 by Prof. Wangari Maathai, the 2004 Nobel Peace Prize Laureate. GBM vision is to create a value-driven society of people who consciously work for continued improvement of their livelihoods and a greener, cleaner Kenya. GBM Phase 1 (1977-1997) focused on planting trees on farms with women and was a notable success. GBM Phase 2 (from 1998) "Tree planting on public lands" focuses on the planting of indigenous trees to enhance the impact of environmental conservation and to preserve local biological diversity. Simultaneously individuals and groups are encouraged to continue planting trees on their farms.

18. The **GBM/AFD Aberdare Reforestation Project** was initiated in 2006, through the French Agency for Development (AFD) funding in continuation with a feasibility study. It is part of GBM second phase and focuses on watershed conservation issues. AFD funding of €

1,300,000 constitutes 61.7% of the Project budget. GBM contribution and local communities provide respectively 5.5% and 32.8% (in kind for this last figure). In brief, the Project covers 13 constituencies of the Central Province on the Western, Southern and Eastern slopes of the Aberdare range. This Project was to rehabilitate 2000ha of degraded sites within gazetted forests and to plant trees on public sites. Women groups have been targeted as the main actors of the rehabilitation of degraded forests through the plantation of indigenous tree species. The Project also aims at improving livelihoods of the communities through the diversification of their activities disseminating forest protection initiatives, and creating the conditions for replicating this Project for full rehabilitation of the watersheds of Kenya.

Part 2: Project diagnosis, organization and management

19. The Project was initially affected by an important staff turnover in its management which affected its development and expected progress. Since 2008, the Project is implemented by Mercy Karunditu, a Project officer with an MSc in Agroforestry and Rural Development. The Head of the Project directly interacts with all Extension Officers at constituency level who are assisted by the Green Volunteers who are in charge of networks of nursery groups and the Green Rangers who provide security services in planted gazetted sites.

20. Five **Local Coordination Units** (LCU**)**, recently created**,** perform the steering role at field level. A LCU is made up of a GBM Extension Officer, the KFS forester in charge of the Forest Station, the Aberdare National Park senior warden, the area Agriculture Extension Officer, the local Water Officer, local leaders (e.g. Councillor).

21. The **Steering Committee** (SC), made up of five members (GBM, AFD, KFS, KWS, Ministry of Water and Irrigation), meets on notice on matters to ensure that the Project is progressing in the intended direction but higher frequency and consistency of the meetings, for action, more commitment from certain members of SC, and formalized links with the LCU are necessary.

22. The GBM AFD Project is implemented at the sub-location level (the smallest administrative unit in the country), and managed at the constituency level, the political unit of the country. A reflection on the (spatial) reality of watershed concept and management should be taken into an account for the best efficiency. To facilitate the quick address of more global issues of the Project like the watershed management concept, the recruitment of a Programme Officer should now be done without more delay.

23. Monitoring and evaluation: The reporting of all the activities of the Tree Nursery Groups, from the group creation to 24 months after planting, is based on the 10 steps procedure and on 12 forms that are to be filled out at each step. The institution starts with Form 4, which indicates that a group has formally come into the GBM fraternity after being duly registered with the Ministry of Culture and Social Services. Through Form 5, the group will report the number of seedlings raised in the nursery, through a number of other forms, the group will report all actions in the field up to six months after planting when the group does its survival count. Most of these actions are done under the supervision of the extension officers. All these forms are received and submitted to the head office by the extension officers; and data is keyed into the data base system. Plans are under way to link it with the GIS and Financial system.
As the objectives of the follow up are also to improve the procedures and the knowledge based upon experience, the forms need to be modified to take the species comportment into

account. As the knowledge of the species behaviour is essential for the future, a new procedure to statistically follow the planted parcels has to be build up to include the survival rate per species at 6, 12 and 18 months after planting and to include the measurement of the height of the transplants 24 months after planting.

24. GBM needs to conduct **self evaluations** from time to time to determine the direction of the various Projects it is implementing. Impact monitoring started after the recruitment of a Monitoring and Evaluation Officer in April 2009. It would be expected that methodologies will be developed to systematically collect information on variables of impact, such as: environmental, food security, IGA and peoples' livelihoods improvement, empowerment, winning people to environmental conservation (at higher levels).

25. External expertise is low; the biodiversity study was not done as early as initially expected, the socio-economic study has not been conducted yet and external expertise has been used very little to assist in technical aspects. Environmental baseline study is essentially informative but it is a starting point for further comparative studies. The socio-economic study is essential to understand the uses of the compensation grants and to know how they contribute to the poverty alleviation in the Project area and should also focus on the socio-economic impacts of GBM older tree plantations.

26. **Relationship with the Project donor, interaction with other donors:** Some donors of GBM are acting in the Aberdare area on same or similar issues: AFD and USAID on Tree and Watershed issues and WB on Trees and Bio Carbon issues. They regularly meet and basic information (reports, etc) is exchanged between these Projects, their managers and donors. As AFD and USAID Projects have common objectives, work with the same categories of communities and stakeholders, and are facing the same challenges, they should interact more, notably at methodological and impact evaluation levels; and reciprocal participation in the respective steering committees. Acting with GBM, the World Bank does not finance any tree-planting Project; in contrast, the WB has a trust fund that aims to pay for bio-carbon sequestration; but carbon price in that Project is very low and below the actual rate and should be negotiated in the future. Actually, AFD is funding GBM planting in bio-carbon sites in addition to the Project. Carbon sequestration using indigenous species in gazetted forest is an option that should not be neglected. But the use of pioneer fast growing species is more appropriate than others slow growing species to reach the objective of the restoration of the forest that could be done at lower price while protecting against browsing and fire.

27. **Relationship with technical Ministries and Services:** The Project has strong relations with KFS, KWS, The Ministry of Water and Irrigation that are involved in the steering committee; so advice from these structures can be easily integrated in Project management. The KFS provides the communities with advice on tree species selection, provides the planting sites in gazetted forests, provides transport at certain times and will continue to care for the trees beyond the Project period. Nevertheless, there may be some difficulties resulting from differences in approach between GBM and KFS especially with the PELIS programme. The Kenya Army provides also transport and labour to assist the planting.

28. Relationship with Research is poor and insufficiently explored. Scientific background and basic data are little used by the Project. ICRAF library and services and those of University and other R4D organizations could be much more utilized.

29. **Training and capacity building:** The GBM training and capacity building given to extension officers (EO) and the tree nursery groups is important, and organized at Lang'ata training centre, Nairobi; it is the duty of the EO to extend training to the groups in the field. (Topics: seed production, nursery, food security, civic education and advocacy and Project management). Between 2006 and 2007, the 14 training/mobilization events were organized to train 1270 members; but most of training has not been put into trainer manuals form so that nothing was given to the TNG such as some aid memoir kind of pamphlet. It is imperative for GBM to have the training materials put in form of manuals like the civic education one. It is also important to put the TNG trainings into do-it-yourself pamphlets, which can be distributed to the group members. The trainings to extension officers are essentially practical and it should be advantageous for them to get a prospective overview through more information/re-fresher courses on strategically global land and forest management.

30. Technical and support tools: The Implementation Manual and Rules of Procedures of the Project have been recently revised but as far as reflections on compensation procedures are needed, that manual will probably evolve in the near future. The new highly performing computer system will serve for the analytical accountancy and for the Geographical Information System; so that GBM will have excellent tools not only for monitoring and evaluation of their Projects but also for managing them. GBM has to develop a scientific follow up of the Projects (environmental, economical and social impacts) with the help of external consultants associated with PhD students, research centres and universities. GBM also needs a technical and scientific library.

31. **Internal communication:** as all the Projects have the same global objectives, we recommend multiplying inter-Projects meetings to promote the exchange of experiences, to find joint solutions and to reinforce the GBM spirit; in addition it seems necessary to produce an internal GBM newsletter. **External communication** is essential to internationally promote GBM actions and to help in fundraising. The GBM internet site has to be improved by adding new pages presenting all the current Projects including video clips, data on trees planted, on tree behaviour and growth, on people incomes increase due to wood production and other products and services through GBM programmes and Projects. All these data should describe the current results and developments in the rural livelihood due to GBM actions.

32. Finance and accounting system and GIS system

These are linked through a relational database, allowing the synchronization of finance and geo-spatial data and most field activities (sites, nurseries and plantations) and financial operations (compensations). This is a very good tool but it remains to be developed and updated.

33. The Compensation system: according to the Ten Steps procedure, the compensation starts 6 months after planting, but it takes at least three months more for survival verification and payment of KShs 5 per seedling surviving. For the groups such a procedure is too long, beyond the fact that the token they are receiving is very small. Hence, it is recommended to have a first instalment of KShs 3 immediately after planting, paid independently of the survival rate, but taking into account all the work done in the nursery and at planting stage; and KShs 2, six month later, based on seedlings survival. Thereafter, the system would continue to run for the rest of the two-year period as currently managed by the Project.

Part 3: Achievements and field results

34. Local mobilization: 516 Tree Nursery Groups in 104 networks representing more than 7500 households, and about 60% of women, have been mobilized, on a voluntary basis by the Project. There is a high spirit of voluntarism, which drives the groups to endure a lot of difficulties. Such a mobilization has been the driving force of GBM since 32 years.

35. Local contribution: The number of days spent by the groups in the nurseries and tree plantations is high and constitute a considerable contribution in kind, work and money. Compared to the feasibility study amount of Euros 689,655, the community surpassed their contribution target by 12%, without taking into account all the other inputs that the community made, like using their own money, their own equipment/implements, giving out their own plots, etc. GBM assistance with potting bags is quite substantial but insufficient; GBM also assist the groups with fuelling KFS vehicles to transport seedlings and people to planting sites, also with carrying soil for some of the nurseries.

36. **The "10 steps and 12 forms" procedure**: is notably expected to deliver in time basic data on successive field operations and corresponding reporting, according to dedicated tasks and responsibilities. But the system in its application appears slow or constrained by various reasons, notably logistical issues including transportation of local Project staff.

37. Indigenous species knowledge and follow-up : the number is high - more than 40, with 10 to 12 dominant species, while little is known on most of these species: reproductive biology, ecology and silviculture from seed harvesting and handling to tree planting and plantation management in pure stands or in agroforestry systems. Accounting of trees at nurseries and planting sites are globally done according to 3 broad categories: indigenous, exotic and fruit trees species. Without detailed data (survival, growth) per species it is impossible to ensure the best monitoring of the plantations according to site specific conditions (soil and climate, land pressure, etc); and one may consider these plantations somehow experimental. The lack of fully rationalized selection and design of candidate tree species, with characterization and prioritization done on scientific basis, is a limitation to species diversification and watershed rehabilitation. Hence, it is suggested to set up a small unit (or to constitute a team) aiming at filling the methodological and scientific gap, in collaboration with University and research and knowledge centres.

38. Seedling production : 3,281,817 seedlings were ready for planting from 2007 to 2009 and an additional 1.2 million for further planting is a high figure while not sufficient to asses the success of tree planting and the development of plantations. The number of seedlings raised in nurseries have to be counted by species and compared with corresponding planted seedlings, and on each site, in terms of survival rate and sanitary conditions at successive intervals of time after tree planting (at 6, 12, 18 and 24 months); this will allow to accurately justify the compensations to be paid to the farmers and ensure the needed follow-up of the plantations.

39. Technical knowledge and local experience of TNG in the management of their nurseries (constraints, improved practices, etc.) are unequally shared between the groups. Some of them do not totally master certain techniques. Technical and scientific knowledge on nurseries and species raised (frequently newly introduced) is necessary to correctly manage the nursery schedule from seed harvesting to seedling plantation stage. Until now, most of this knowledge is lacking – or for the least it is insufficiently gathered, and be refreshed.

40. Attendance of TNG members: it is usually strong at the beginning of the planting season, diminishes with successive operations – as labour force is required at the same time to initiate the cropping season. This unequal contribution of members to plantation work is taken into account by the group (chairman and its treasurer) at the time of the compensation payment. At TNG level, 48 groups from the 564 initial TNG left the Project since 2007.

41. **Tree planting and mixture:** holes are made before the onset of the rainy season (about 1100/ha). KFS and the Kenyan Army regularly provide their services for seedlings transportation. The species mixture in planting is entirely made by chance – as it comes by the planters, and depends largely on the numbers and availability of seedlings raised in nurseries. After planting, weeding is done two to three times during the rainy season; and watering is done during the dry season when needed. Green rangers do the follow-up and watching of the plantations with the assistance of members of the groups.

42. **Counting of tree survival**: it is based on a sampling rate of 50% and this is largely representative. As a whole, survival rates on the various sites planted are satisfying (>50 %) and in most cases good (> 75%), with the exception of the driest site, on Kikuyu escarpment due to livestock pressure and drought. On such a site, temporarily fenced blocks (3 to 5 years) should be experimented on with the view to allow and assess natural regeneration.

43. **Number of trees planted**: from 2006 to 2009, the Project planted a total number of 3,817,560 trees: 1,919,599 trees (about 1900 ha) in public lands, and 1,897,861 (about 1800 ha) in gazetted forests. The target of planting 2,000,000 trees (about 2000 ha) has largely been surpassed; and the total of surviving trees, about 2, 300,000, is itself overtaking the target.

44. Up dated and detailed data on plantations: appears difficult to collect in time and space because of the high number and large dispersal of the sites which have to be controlled each month (TNG) and at least two times a year (planting sites). As transportation is the main constraint, the Project should purchase, as soon as possible, motorbikes for the extension officers and bicycles for the green rangers. This will allow them to regularly visit, control and advise any work at nursery and plantation site levels; and therefore have more time devoted to other tasks, such as reporting, meetings and continuous professional training. Secondly, an operational link should be established between the nurseries database, the tree plantations database, the GIS database and the accounting database (survival and compensation system)

45. Compensation and delays: the system is based on tree survival rates and is a token of appreciation that GBM provides to the groups. Due to verification delay, the planting of 2006 was compensated in 2007, and that of 2007 in the year 2008. For these two years, the compensations respectively amounted KShs 6,464,301 and KShs 4,132,629; As a result, the figure for the planting of 2008 was not yet available at the time of the review and the last payments of the compensation will also have to be managed without too much delay after the end of the Project (in 2011, following the last plantation of 2010). In this perspective, some provisions need to be done by GBM and discussed with the donor.

46. Joining CFA and FMP initiatives: the Project should take advantage of the Community Forest Associations (CFA) and Forest Management Plans (FMP) initiatives to better prepare and involve the concerned TNG and their networks, with the view to participate in an integrated management of the Aberdare Forest ecosystem, including Water Resources User Associations, Community Managed Wildlife Conservation Areas, etc. GBM

is identified as a major key player in such initiatives and has been involved in fostering the dialogues for formation of four CFA and the writing up of their FMP

47. **Visibility:** it is poor as visitors cannot get minimal information of the Project and share its experience on the web site. Expected web pages should be produced without delay before the end of the Project. Meanwhile, a school sensitization program has been ongoing, and a civic education manual has been adapted for public awareness. The video documentary is also in the production stage.

48. Replicability and scaling up: the Project methodology is simple and easily understandable by the target groups and other stakeholders. The conservation of the five major water towers of the country has taken a great national priority and international interest; so the Project has high replicability in similar areas.

49. **Management and monitoring:** since the recruitment of a Project Officer and Acting Executive Director, reporting to AFD has been adequate, and the required reports and returns are made in time; but expenditure of funds is delayed, especially compensation payments: for 2008, they are done only at 35%, when they should be accomplished by June 2009.

50. Impacts and limitations from the Project achievements:
- A large section of the local community in the Aberdare region, properly mobilized, truly adopted environmental conservation, and they will continue to commit in the long term;
- This community, through TNG, learned how to organize themselves effectively for large scale public enterprises and how to network with stakeholders on the same;
- TNG acquired skills in nursery and planting techniques that they will continue to use for a long time for the good of the country, and Aberdare area notably;
- At 3 to 4 year old, the impact of trees planted in degraded forest sites is certainly modest in terms of water conservation and rehabilitation of forest ecosystem in the Aberdare. Expected impact in future will depend on the survival of these trees when mature and fully functional, individually and as an ecosystem - but in any case this impact is difficult to assess
- The group members planted trees on their farms that will provide them firewood, timber, etc. As a secondary objective, these trees will contribute to soil and water conservation; hence, they are part of an integrated watershed management, and should not be ignored.
- A pool of well trained extension staff is in place. They will continue to be available for GBM work and for other NGOs and Projects in the country, for the benefit of the nation
- The group members have been able to pay school fees with the compensation money and also provide food to their families even if for short periods; but very few started income generating activities to improve their livelihoods or families' welfare.

Part 4: Proposed actions for the extended one year of the project (2010)

51. **Adjustment of the compensation system**: GBM has to adjust the compensation system so that a first part of the KShs 5 is immediately paid after tree planting (KShs 3), and the second part is paid after survival counting and checking (KShs 2).

52. Provision for compensation: GBM to make provision of funds, in consultation with the donor, for the payment of the last plantation and its compensation - before 2011;

53. Income generating activities (IGA): proposals to be studied in depth (diagnosis and design type) through external expertise. IGA should contribute both in environmental

conservation and livelihoods, and in a sustainable manner, and be a matter of training to group members: how to start up an IGA, concepts and applications, requirements, including organizational, financial and marketing issues, registration, technical backup

54. Initiating a micro-credit system, in relationship with compensation: taking advantage of the proposed adjustment of the system and bridge it with micro-credit system for the groups on a pilot basis. Experts should be hired to study the (best) conditions of promoting micro-credit, in relationship with income generating activities.

55. Membership evolution and youth mobilization: due the disengagement of young members from certain TNG, GBM should conduct a comprehensive analysis of the situation and design strategies to attract the youth and explored their contribution in possible IGA initiatives, and entrepreneurship federating business and environment issues.

56. **Programme officer recruitment:** this is very much needed and to be done without any delay. One of the first actions of the officer could be to co-organize a workshop on community based management of forest (FMP) that constitutes a key entry point for further GBM and CFA activity in gazetted forests, their buffer zones and corresponding watersheds.

57. **Strengthening the Steering Committee** with high level representation and full commitment from GBM, donor and GOK representatives, to notably boost advocacy mechanisms, discuss the lessons learnt, develop partnerships, and consolidate actions -in addition with due critical appreciation and elaborated guidance of the Project for its best development and largest impact. Discussing the results and proposals of this report/mid-term assessment should constitute a priority in the agenda of the next Steering Committee.

58. **Scheduled socio-economic study**: the TOR could include the assessment of the efforts of the groups in giving time and money to establish the nurseries, plant trees, and take care of them; and of the net monetary value/outflow from the groups to the tree planting activity for social good. This information would be useful for arguing out issues on designing policy on community led environmental conservation. A study on the impact of on-farm tree planting is necessary, for example assessing the uses and impact of *Eucalyptus spp*, *Grevillea robusta* and indigenous species on the livelihoods of farmers as well as on the environment, with the objective to promote the organization of small farmers/tree planters so as they get the maximum returns from a rationalized and sustainable exploitation of their mature trees.

59. **Reflections on tree plantations and watershed issues:** initiate workshops on how to appropriately manage the plantations and rationalize the choice of the species as methodological and scientific basis in tree planting and management, and reflection regarding watershed issues are insufficiently developed.; reflection to be axed on watershed concept and integrated management, through soil and water conservation technologies, conservation agriculture and other ways of ecological intensification etc. within delineated (sub-) catchments-with the view to facilitate the preparation of forest management plans with CFA, in application of the Forest Act, make their voice listened to, and strengthen GBM action.

60. **Evaluation and dissemination of results:** GBM to initiate a systematic collection, analysis and classification of relevant field data and information and to design a workable approach for dissemination and sharing. Field data should be confronted to bibliographic information; regular measurements of trees (through ad hoc methodology to be designed) and

forms for assessing and monitoring both environmental conservation and socio-economic impact of the project will give solid results for the design of further plantations on other sites. The priority is to assist the TNG to improve their nursery records: types and numbers of seedlings, income and expenditure, work records, challenges being faced, and so on.
Students (under and post graduates from the University of Nairobi) could be associated in field data collection contributing notably in selection process of indigenous trees and management of indigenous germplasm. Environmental and socio-economic indicators could be defined for the monitoring and evaluation. Disseminating the results through workshops, communications, web site and publications should be initiated to publicize the GBM experience.

61. GBM external and internal communication: to reinforce it external communication, GBM has to develop the missing web pages (including videos) on the project, possibly by contracting a web master; on internal communication side, it is recommended to develop a newsletter in kikuyu, aiming at sharing experiences, technical and organizational aspects, and at informing on various issues from GBM and stakeholders, to reinforce the spirit of the GBM groups membership. A consultant may be needed to design this newsletter.

62. Training and capacity building: improve training of extension officers by extending its scope to integrated land management, related socio-economics issues, conservation of the environment, sustainable development, etc. and refresher courses on silviculture and other practical matters; design an improved curriculum for the groups on tree nursery techniques and articulate this in a TNG training manual and practical do-it-yourself pamphlets for TNG. Editing of training materials would need a consultant.

63. Technical aspects, at nursery and planting sites levels: significant technical improvements at nursery level as well as at plantation level are needed and possible at one year scale. These are detailed in the **Appendix 13**. GBM should provide a minimum of water equipment that the TNG cannot afford: water tanks and pipes; and in some cases water pumps and other tools; and the recruitment of nursery attendants for some nurseries.

Part 5: For the future – proposals

64. Integrated land use and watershed management approach: as the effectiveness of a watershed is essentially functional at global scale with land use variations, its management has to be studied through an integrated approach, bridging its various scales and components and from which a model could be designed as a pilot project applicable on other watersheds.

65. The **Aberdare ecosystem**, consists of three imbricate zones: 1. the central high elevation National Park that is now protected by an electric fence: its efficiency in water conservation will grow with time; 2. the surrounding gazetted forests that will soon have their own Participatory Management Plan thus a sustainable management that will reduce anthropogenic pressure and improve water catchment efficiency; 3. The largest zone, of adjacent farmlands, from the forest line to the lowest slopes where farmers have been planting many trees with the support of GBM for a long time, but tree based systems could be intensified for water conservation improvement. The hydrological network interconnects the 3 zones which have to be integrated in a global land use and watershed management plan, through the:

66. Development of a global land use engineering strategy: based on both agricultural production improvement through ecological intensification, and on restoration of all ecological services rendered by ecosystems. In this perspective a feasibility study is needed which would propose the selection of water (sub-)catchment on which action be concentrated after, characterizing it, assessing ex ante the conditions of local communities participation and notably adoption of technologies and innovations in a sustainable way. This could be done during the last year of the Project in good continuation with its activity through a workshop on global land use and watershed management in the Aberdare region, involving all concerned stakeholders and donors. The workshop should give ground to set up a feasibility study.

67. Follow-up of tree plantations on forests or public sites should be done to improve knowledge on indigenous tree species that are often slow growing and will not have significant environmental impact before 10 to 20 years. This follow-up will assess tree performance, ecological requirement, growth and potential environmental impacts and give a solid scientific basis for future plantations on tree management, notably, in agroforestry systems, Collaboration with university and research centres (through students involvement) is needed. In addition, it is recommended to deal with market organization and issues, so that the farmers can optimize their revenues (sale of wood and non-wood products); and corollary to come up with techniques for improving the quality of these products through performing processing techniques to guarantee value added and the best prices to the producers.

68. Income generating activities (IGA): A specific GBM design for IGA promotion to be thought about based on micro projects, so that contribute significantly in raising the standards of living group members and that have an environmental conservation value. Training has to be provided on how to start such IGA, along with production technical backup and facilitation on marketing issues (access, etc) . Seed capital to start up IGA should be provided to groups through a micro-credit system that will be recovered (at least partly) from compensation. This has to be programmed and tested with appropriate external expertise.

69. **Replication to other water towers:** the current project methodology is simple in its design and easily understandable by the target groups and other stakeholders; hence and although improvable, it is a highly replicable model for similar degraded areas and watershed

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List of Abbreviations

AEZ	Agro-Ecological Zones
AFD	Agence Française de Développement
CFA	Community Forest Association
CBD	Convention of Biological Diversity
CBS	Central Bureau of Statistics
CDM	Clean Development Mechanism
CIRAD	Centre de coopération Internationale en Recherche Agronomique pour le Développement
CITES	Convention on International Trade in Endangered Species
CO_2	Carbon dioxide
DRSRS	Department of Resource Surveys and Remote Sensing
EO	Extension Officer
FAO	Food and Agriculture Organization
FCA	Forest Conservancy Areas
FGD	Focused group discussion
GBM	Green Belt Movement
GIS	Geographic Information Systems
GOK	Governement of Kenya
GR	Green Ranger
GV	Green Volunteer
IGA	Income Generating Activities
ILRI	International Livestock Research Institute
KEFRI	Kenya Forestry Research Institute
KENGEN	Kenya Electricity Generating Company
KFS	Kenya Forest Service
LCU	Local Coordination Unit
MDG	Millennium Development Goals
MEMR	Ministry of Environment and Mineral Resources
NP	National Park
NWSS	National Water Services Strategy
PELIS	Plantation Establishment and Livelihood Improvement Scheme
PFM	Participatory Forest Management
R4D	Research for Development
RLA	Registered Land Act
SC	Steering Committee
TEK	Traditional Ecological Knowledge
TNG	Tree Nursery Group
TOR	Terms of Reference
USAID	United States Agency for International Development
UNEP	United Nations Environment Program
UNFCCC	United Nations Framework Convention on Climate Change
WARMA	Water Resources Management Authority
WB	World Bank

1. Introduction

The Mid Term Review of the Rehabilitation of the Aberdare Forest Ecosystem Project which is funded by Agence Française de Développement (AFD) and implemented by the Green Belt Movement (GBM) took place in Kenya between September 17 and the October, 2, 2009.

The mission was carried out by 3 consultants:

-**Denis Depommier**, Regional Director, CIRAD. Professional, with 27 years international experience in twelve countries, mostly in Drylands and Highlands of Africa, with qualifications in sustainable management of Forestry, Agroforestry/Social Forestry and Livelihoods .

- **Munene Kabengi**, independent Development Consultant with 22 years of experience in extensive training in participatory approaches, process facilitation, capacity building and empowerment .

- **Dominique Louppe**, Senior Forestry Expert, Environments and Societies Department, CIRAD. Professional, with 31 years experience, of which 25 years in sub-Saharan Africa, in Forestry, Agroforestry and Silvicultural research and extension, and in scientific edition – Head of the Mid Term Review mission.

The mission was conducted over a two week period, according to 3 successive steps: i/preliminary meetings with GBM and AFD, first analysis of Project documents and preparation of the field mission, axed on Southern, Western and Eastern parts of the Aberdare;
ii/ one week field mission in 6 selected constituencies of the Project with visits to plantations sites and nurseries, along with meetings of GBM staff and main stakeholders ; iii/ supplementary meetings with stakeholders in Nairobi and readings of GBM documentation; data analysis and writing up of the preliminary report.

For detailed information on the mission, see:

- *Program of the mission* in **Appendix 1**
- *List of persons met,* in **Appendix 2**

PART 1: ANALYSIS OF THE CONTEXT

2. Terms of references of the Mid Term Review AFD/GBM

2.1. Objectives of the Review

The main objective was to formulate an independent and reasoned opinion on the Project, and specifically to:

- Assess its progress towards its stated goals,
- Assess the Project approach and methodology,
- Identify constraints hindering such progress,
- Provide recommendations for the remaining Project implementation period, and recommendations for a possible continuation/reorientation of the Project.

The detailed Terms of Reference (TOR) are attached as **Appendix 3**

2.2. Approach and Methodology

The consultants started the process by collecting and reviewing all the Project information and documents, namely the Project feasibility study, the Project legal agreement, the Project progress reports, the audit reports, the AFD mission supervision reports and GBM internally generated reports and notes (see list of documents consulted, in **Appendix 4**).

There after, the consultants sought to appraise themselves of the Project context and design by having interviews with various staff at GBM headquarters, and AFD regional office.

Within the effective time of the mission (15 days), 8 days were devoted to field visits in the Project area focussing on TNG, their nurseries and the Project planting sites, through 6 of the 13 constituencies were the Project is operating: Lari, Limuru, North Kinangop, Kipipiri, Gatundu North and Kigumo constituencies were successfully visited along with the Head of the Project and extension officers of these constituencies and neighbouring ones (see **Appendices 1 and 2**).

Programming of the field mission was established with the Head of the Project in Nairobi
At the same time, interview forms were prepared in the perspective of discussions with focused groups and field documentation (topographic maps, GIS images) was gathered.

On the ground, random checks were done in tree nurseries and planted sites covered by the Project. Here, the consultants held intensive sessions with the Project target groups, the members and leaders of the Tree Nursery Groups (TNG), using focused group discussion (FGD) interview techniques. More information was collected from key informants such as the extension officers (EO), green rangers (GR), green volunteers (GV), officers of collaborating agencies (KFS, KWS,

Ministry of Water, local administration). Due effort was made to ensure that there was balanced gender participation in the FGD, and all emerging issues were exhaustively addressed.

The FGD were conducted at the tree nursery sites, in as much as this could allow, so as to make live reference to the pertinent issues confronting the groups with regard to nursery establishment and management, and tree planting strategy and logistics (see Interviews guidelines in **Appendix 5)**. Furthermore, this afforded the consultants an opportunity to satisfy themselves with details concerning the quantity and quality of the groups' capacity to raise seedlings for the Project.

The consultants also visited the sites where the Project had planted trees. In these sites, they were able to observe survival and growth of the trees, the planting techniques, sampling methodology to assess tree survival, attendant environmental problems, etc, and also to engage the extension officers and group members in dialogue to amplify these issues as they were being observed.

The consultants did not have access to the database in advance to fully discuss the selection of sites prior to the field visits. In addition, once availed, the GIS data lacked some preliminary information (climatic conditions and geo physical conditions) for the planting sites and any primary analyses of the realizations done at these places.

Finally, the consultants had the opportunity to enrich their findings by talking to various GBM stakeholders. These included the USAID, World Bank, headquarters of KWS, KFS and WARMA met in Nairobi after the field trip.

3. Context and objectives of the Project

3.1. Kenya environment, rural development and management of natural resources

3.1.1. Rural development and the degradation of forests and biodiversity

3.1.1.1. Socio-economics and rural development

Over 80% of the Kenyan population live in rural areas under rain dependent subsistence agriculture or cattle farming. Most of this population is poor to very poor as over 50% of the population live on under one US $ per day (AFD/BRL Feasibility study, 2006). Rural population is mainly constituted of small farmers, concentrating in the highlands of the country – Central and Western Provinces notably where they exert high pressure on land and as a whole on natural resources (soil, forests, biodiversity, water).

In these areas, of highest agricultural productivity in Kenya, the rural population whose number has been multiplied by two during the last 20 years, constitutes locally very high densities of more than 600 inhabitants/km² (CBS, 2003, and WRI, 2002). This high increase of the population in rural areas and urban development – with corresponding needs of city people in energy (charcoal) and building materials – is one the main causes of the pressure on forests. The pressure will remain high as long as the majority of the consumers could not access, in a significant way, alternative sources of energy and/or farmlands could satisfy most of the demand in wood energy (trough woodlots, agroforestry), and possibly in other bio fuels.

3.1.1.2. Forests, management and overexploitation

According to Njuguma *and al*, Kenya closed canopy forests, which are essentially located in the humid and semi-humid zones of the country, covered about 1.40 millions ha in 1999, with the following breakdown: 1.06 in indigenous gazetted forests, 0.18 in other indigenous forests, and 0.16 in tree plantations (the cover of the later could be much more, up to twice the given figure, taking into account new planting cycles.

The Aberdare Range, Mount Kenya, the Mau Escarpment, Mount Elgon, and the Cherangani Hills are home to most of the closed forests of the country which together cover about 1 million hectares (Akotsi and Gachanja, 2004).

All types of forests in Kenya were reported to cover about 30% of the country in 1900, and only 6.2% in 2005 (FAO statistics); the closed canopy forests which covered 2.8% of Kenya by the beginning of the last century are now accounting for 1.7% . Nevertheless, current climatic and site conditions would probably not allow having such forests covering more than 12% of the country's area (Njuguma *and al*).

Commercial plantations represent a rather small percentage of the forests: slightly more than 10%, mainly composed of exotic species (*Cupressus lusitanica*, *Pinus patula* and *Eucalypts spp.*). These plantations were developed from the colonial times, for timber industry, at the expense of the natural forests; current plantations remained constituted of the same exotic species and, on average, do not account for more than 3000 ha per year.

Apart from some few private forests and forest managed under Trust Lands, most of these humid and sub-humid forests are gazetted as forest reserves and managed by the Kenya Forest Service (KFS). Management is sometimes shared with the Kenya Wildlife Service (KWS) through a Memorandum of Understanding, where forests are located within national parks and reserves - such as in the Aberdare Forest Reserve.

Past management of harvesting of forest resources has been erratic and poorly controlled in Kenya, with forests lost due to excisions reaching the rate of 5000 ha per year; and as it has been a source of corruption, logging of indigenous trees was prohibited by presidential ban in 1986 – finally with no or low impact on forest conservation.

Now, to succeed in its mission of sustainable management of the forests of Kenya, KFS has to face various weaknesses and constraints, of which the lack of means (equipment, functioning), good management practices, staff commitment and communication, along with security problems (linked to illegal activities, and wildlife), and a drastic lack of human resources: the number of KFS technical staff and "resident workers" has been reduced by 5 since the 90's (4000 staff in 2009). Therefore and through the new Forest Act of 2005 which brings a totally new –community based- approach in the management of the forests, the participation of local population is more than before highly needed and should open a new era as far as sustainable management of forest is concerned.

Indeed, local communities living near the forests (agriculturalists) or having access to them temporarily (pastoralists), have been increasingly encroaching and overexploiting them to satisfy their basic needs (land for food, grazing/fodder, energy/firewood, building materials, etc.) and sustain their livelihoods.
For its energy at household level, the rural population of Kenya is heavily dependant on firewood which represents 89 % of the total consumption of the country, and on charcoal which accounts for 46% of this consumption. But firewood is not exclusively collected in gazetted forests, through legal action (harvest of dead branches, products of lopping, thinning) or illegal way (cutting of living trees or branches without authorization); it also comes from farmlands, and notably from agroforestry systems.

Besides the exploitation of the forests by the local population and their livestock – serving essentially subsistence issues, it is important to distinguish the impact of the commercial and illegal activities, such as the making of charcoal or wood logging in gazetted forests, which is the main source of the vanishing of the forests, or their degradation and the fragmentation of habitats for the wildlife, leading to the reduction of water flows and disturbance of hydrological balance.

3.1.1.3. Biodiversity, richness, local utilization and conservation

Kenya has a high biodiversity: over 6,500 plant species, of which 260 are endemic, and it is second in Africa in species richness regarding birds (more than 1000 species) and mammals (350 species). The greatest concentrations of mammal species (69 to 79) are in Western and Central highlands of Kenya, largely depending on water and food or fodder availability, and specific conditions of climate and habitat. When they are little disturbed, forest ecosystems in mountain areas, constitute local hotspots of biodiversity such as in the Aberdare national park where the recent achievement of its fencing along with corridors to allow the movement of elephants to the adjacent Wanjohi valley and Kipipiri forest, boosts the conservation of wildlife and endangered species (i.e. the mountain Bongo) and reduces human-elephant conflicts (although constraining wildlife migrations).

As pointed out by Kameri-Mbote (2002), protected areas in Kenya provide a habitat for only 30% of the total wildlife resources. High level of biodiversity may be found in agricultural landscapes, especially when they integrate remnants of (secondary) forests, are based on mixed cropping (versus monocultures), and associate various tree species in agroforestry systems. Such agroforestry system based landscapes are found in the Central province, on the Eastern slopes of the Aberdare where the Green Belt Movement promoted tree plantation in farmlands during the last 30 years -through *Grevillea robusta*, the most planted multipurpose tree species and still in high demand with farmers, which may appear as an excessively dominating species in these landscapes. Agroforestry systems, through their species richness and multilayer structure, may constitute reservoirs of genetic diversity and offer niches for wild plants and animals, and finally constitute interactive buffer zones with neighbouring forest reserves.

Biodiversity is an important source of livelihood, especially for poor people in rural areas who may have a strong traditional ecological knowledge of native species and their management – and notably make large use of non woody products: medicinal products, wild honey and fruits, etc. Taking into account this knowledge, notably on trees and shrubs, may help in selecting the right species and sites for tree plantation (in and out of the forests) and satisfy or diversify certain needs of the local population (in food, fibres, medicinal products), while reducing pressure on certain forest trees.

3.1.2. Mountain forests and their role as water towers within river basins

As pointed out in the WRI atlas of Ecosystems and Human Well-Being of Kenya (2007), the high rainfall areas in Kenya's mountains are the source of its largest rivers, many of them running all year-round. The upper slopes of these mountains, when they remain closely forested, provide a complex bundle of ecosystem services - of which water regulation and production in quantity and quality, particularly to the densely settled hills and plains below the steeper slopes. The rivers which drain into the arid and semi-arid lands are an indispensable source of water to grow crops, raise livestock, and support wildlife; they are also the main source of water for urban areas, particularly to Nairobi.

Mountain forests which are referred to as Kenya's five "water towers" can be used to delineate the upper watersheds of the major rivers originating from the corresponding mountain ranges (Aberdare Range, Mount Kenya, the Mau Escarpment, Mount Elgon, and the Cherangani Hills) on which most parts of the country depend for water supply.

Hence, mountain areas and their topping forests command large water catchments which constitute, at the country scale, 5 river basins **(see Map 1):**

- Athi river basin
- Ewaso Njiro basin
- Tana river basin
- Rift valley basin
- Lake Victoria : North and South

Interestingly, the Aberdare range is at the junction of the four first basins, and notably commands, on its Eastern and Southern slopes, large parts of the Tana and Athi Rivers, whose upper catchments and tributaries, through the Sasumua and Ndakaini dams, supply most of water for Nairobi **(see Map 2).** On its Western side, the range gives birth to major rivers supplying the Rift Valley at Naivasha lake level, whereas, on its Northern flank, it supplies water to Laikipia area.

The degradation of these water towers –viz. their forests and allied types of vegetation acting as a permanent ground cover- has already had some dramatic consequences such as the drying up of many sources and the transformation of permanent rivers into temporary ones. As such, dams used for irrigation and hydro-electricity power generation are running below their full capacities (close to three-quarters of Kenya's electricity is derived from hydropower), and increasing water supply problems affecting as many urban areas, and particularly Nairobi as rural areas.

Finally, it is important to highlight here that only 50% of the rural population have access to portable water and water collection may consume up to 3 to 5 hours of women working time per day, and of men too. As piped water is not sufficient, water selling is now a new job in towns across the country. And safe water collection is a major constraint, everywhere.

Accordingly, and considering Kenya as a water-scarce country, restoration of the tree cover in these 5 water towers is a national priority. Fighting deforestation, illegal logging, overgrazing, etc. will not be possible without impacting on the rural neighbouring populations. The Green Belt Movement's long experiences in tree planting in farmlands, its capacity to create awareness, advice, motivate and organise the rural populations are an asset to implement such a challenge.

3.2. The Aberdare range

3.2.1. Biogeographic region and location

The Aberdare range forms part of the central volcanic highlands of Kenya. It belongs as well to the "Afromontane and Bamboo" bio geographic region, East of the Great Rift Valley - which has more plant endemism than on the Western part of the Rift.

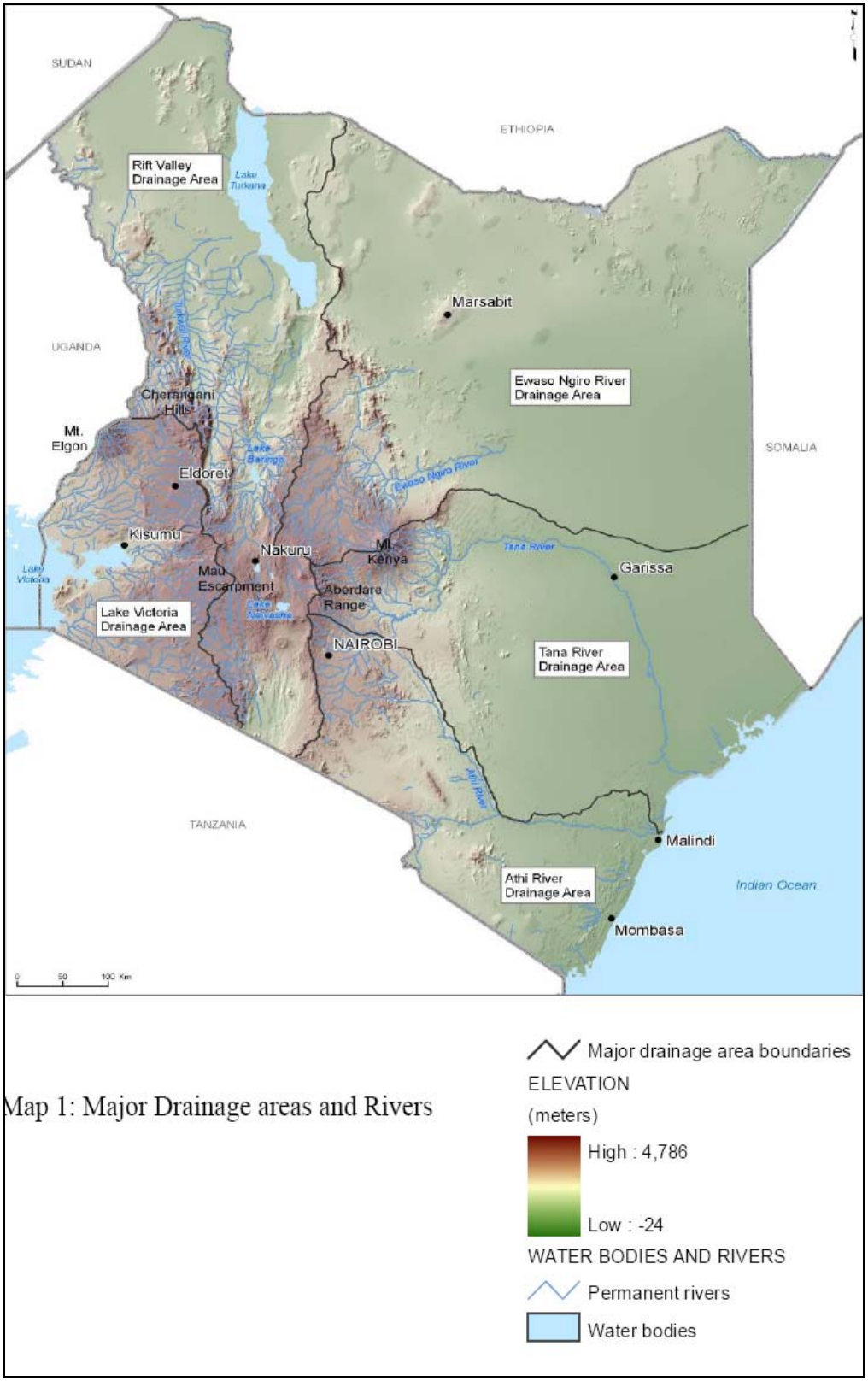
The range lies between latitude 0° 05' and 0° 45' South, and 36° 30' and longitude 36° 55'East – viz. on 120 km northwards from Nairobi and about 40 km at its widest point, between an altitude of 2000 to 4000 m (Oldonyo Setima peak). It bestrides the equator in the central highland zone of Kenya.
The range is situated in the heart of the Central Province, distributed on 7 districts as per the previous delineation, and before constituencies were recently turned into districts: Kiambu West, Muranga North, Muranga South, Nyandarua North and South, Nyeri North and Thika ; Aberdare range extends somehow to the Laikipia and Nakuru Districts, of the Rift Valley Province **(see Map 3) .**The Eastern slopes of the Aberdare range faces Mount Kenya and the two are separated by densely settled and intensively cultivated land units of Murang'a and Nyeri districts **(see Map 3)**. Its Western slopes are steeper, facing the Kinangop plateau and the Ol Kalou plains in Nyandarua District.

3.2.2. Climatic and soils traits

3.2.2.1. Climate

Climate is determined by altitude and wind exposition which affect rainfall (R) and temperature (T). Climate in the Aberdare is cooler and moister than most of Kenya.

Eastern slopes are submitted to an equatorial type of climate, with 1400 to 2200 mm rainfall per year with extended wet seasons, the South-East receiving the highest precipitation (with a dry season of only one to two months).



Map 1: Major Drainage areas and Rivers

Source: WRI, Nature's Benefits in Kenya, 2007

Eastern side falls within the tropical moderately cool regime of the Aberdare (mean maximum T: 25.8 °C, mean minimum T: 10.3°C). At high elevation (moorland, in the National Park), the mean minimum daily T goes down to -2° C.

On the Western side, rainfall reduces sharply, from about 1400 mm at the forest border to less than 900 mm (upper valley of Malewa river) with 3 to 4 months of dry season. In most parts of the range, rainfall distribution follows a bimodal pattern (axed on March-May and October-November), with the exception of the Northern side, which has a tri modal pattern (additional peak in July-August, 3 to 4 months dry season).

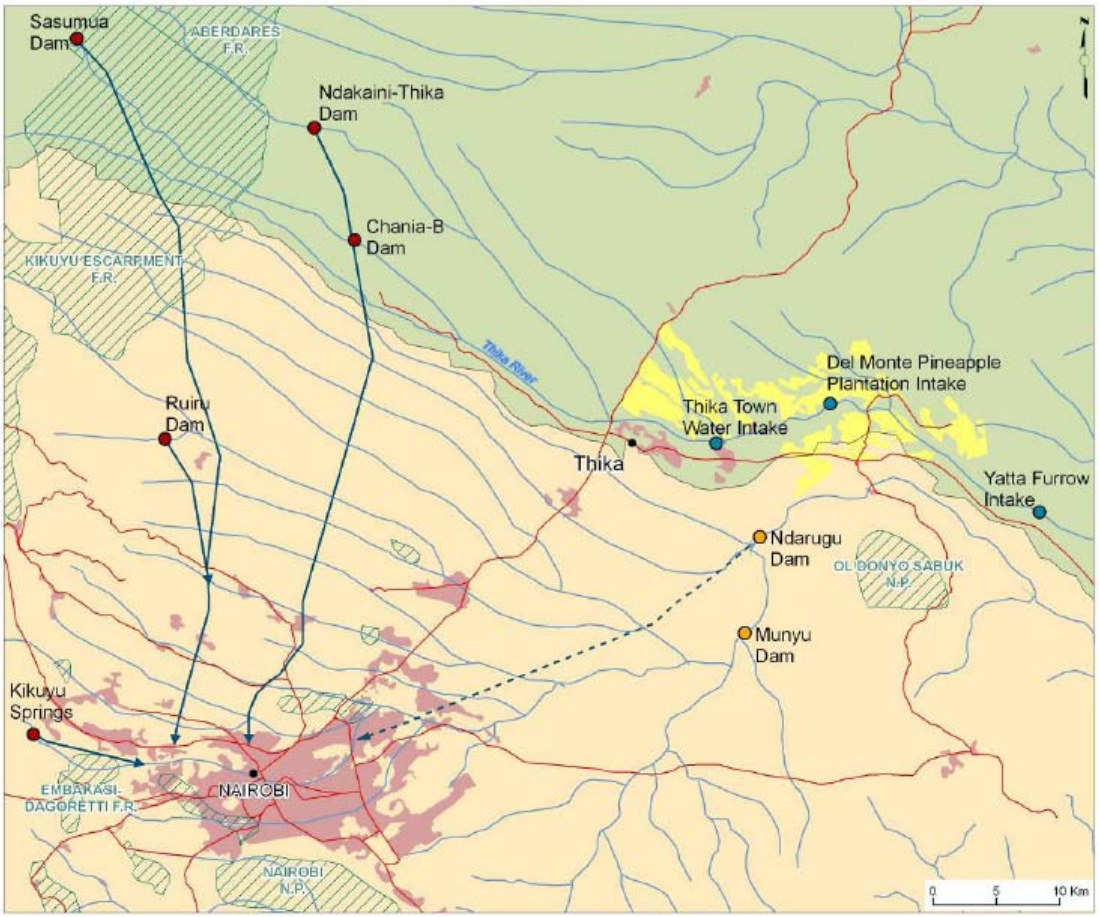
The geographic distribution of annual rainfall in the Aberdare range and its surroundings is as follows (see **Tables 1 and Appendix 7,** for more detailed data):

Table 1: Annual rainfall in Aberdare range and its surroundings

Zones	Locations	Altitude (m)	Rainfall (mm/year)
Centre	Aberdare national Park	2600	2283
West	Geta Forest Station North	2600	1185
	Kinangop	2630	1137
South West	South Kinangop	2550	1142
South	Limuru Uplands Kikuyu Dist. Office Kiambu Dist. Office	2300 1970 1700	1248 1014 1043
South East	Kieni Forest Station Murang'a-Gateigor	2500 2000	1721 1601
East	Karatina Agric.station	1760	1508

Source: Kenya Meteorological Department

The highest annual rainfall is observed in the centre of the Aberdare range and on its Eastern and South Eastern slopes (> 1500 mm) whereas the Southern and Western sides receive between 1000 and 1200 mm, even at high altitude (2500 m). This difference between the two sides, notably on the duration of the dry season, is at the origin of different cropping systems, and population density – and is to be taken into account in tree seedling selection, production and plantation, notably on the lowest (and driest) parts (such as the Kikuyu escarpment).



Map 2: Nairobi water supply

OTHER FEATURES
- Major roads
- Permanent rivers
- National parks and reserves

WATER PIPELINES
- Existing pipeline
- Proposed pipeline

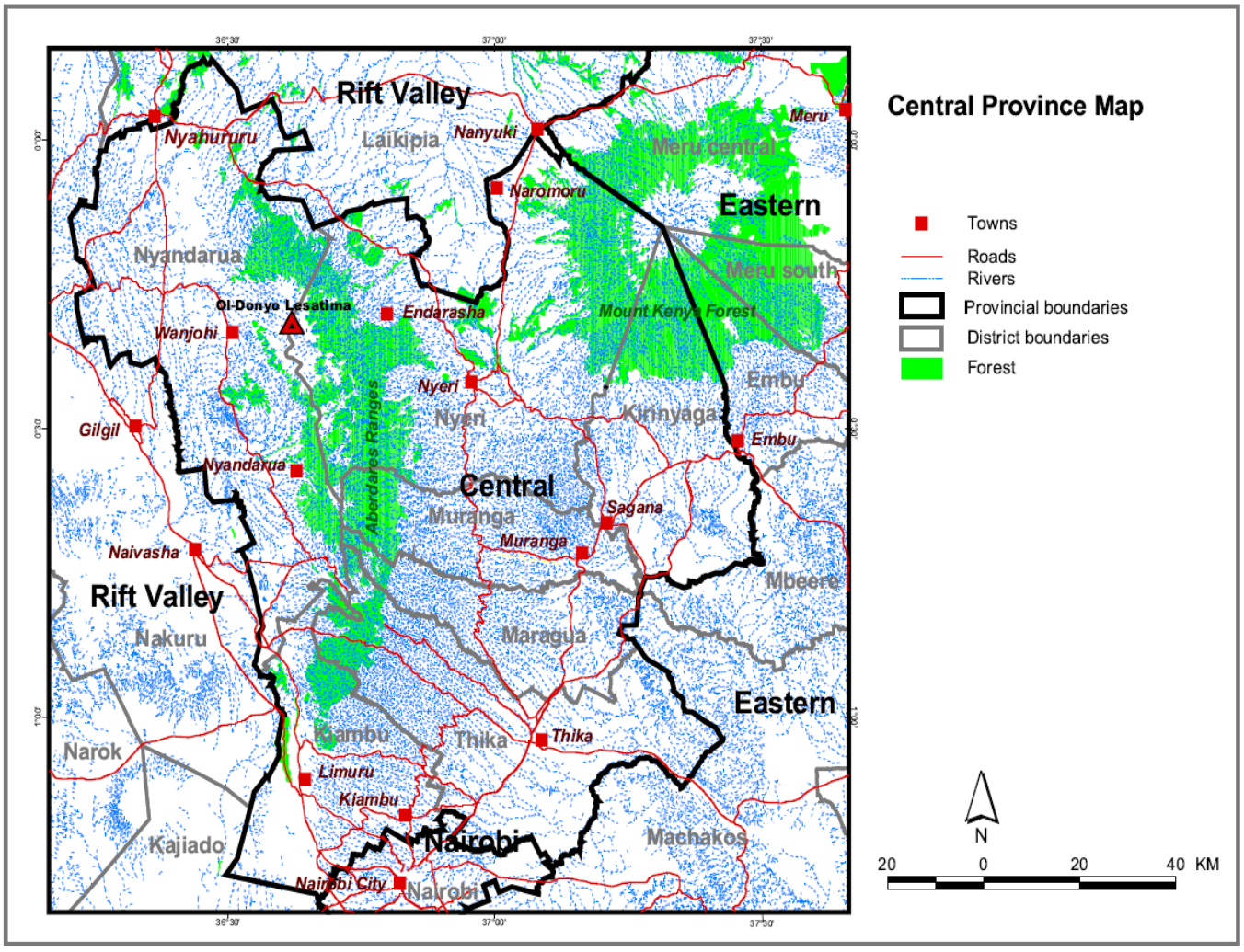
WATER WITHDRAWAL SITES
- Existing supply sites for Nairobi
- Proposed supply sites for Nairobi
- Other important water withdrawal sites

IMPORTANT LAND COVER FEATURES
- Urban areas
- Pineapple plantations

DRAINAGE AREAS
- Tana River drainage area
- Athi River drainage area

Source: WRI, Nature's Benefits in Kenya, 2007

Map 3: Aberdare Range within the Central Province



Source: ICRAF GIS Unit 2009

3.2.2.2. Landforms, main rivers and soils

According to Nganga *and al* (1990), nine types of landforms can be isolated:
the Southern Laikipia plateau (1500-1800 m, on North), the Ol Bolossat plain (2300-2500 m, North-West), the Kinangop plateau (2400-2700 m, West), the Nyeri plain (1800-2000 m, on East), the Aberdare dip slope (1800-3000 m), the moorland plateau (> 3000m, on its Centre), the Northern Aberdare ramp, the mountain summit (s) and the Satima fault scarp (close to the OlDonyo Lesatima peak).

Some of the major tributaries draining from the Aberdare range include: Thika, Maragua, South Mathioya, North Mathioya, Gura, Chania and Sasumua (and its dam providing water to Nairobi) draining the South-Eastern and Eastern flanks (Upper Tana river watershed and Athi river); the Amboni, Ewaso Njiro, Engare Ongobit and Syaurai draining the Northern part of the range (Upper Ewaso Njiro watershed); and the Engare Syang, Katiri, Wanjohi, Malewa and Kaheho rivers draining the Western scarps of the range (Rift Valley watershed).

The entire Aberdare Range has been subjected to intensive tectonic disturbance and subsequent volcanic activity. Hence, soils have been derived from massive lava flows, deep beds of volcanic tuff and ash showers of the geological formations –dating from tertiary period to recent volcanism.

Soils on the upper Eastern slopes of the mountain are of basaltic origin, dark reddish brown in colour, very deep, well drained clays which are naturally highly fertile (of alkaline nature). Soils on the Western boundary are more variable, being of medium to high fertility but interspersed with areas of lower fertility and poor drainage (FAO, 1997).

Main types of soil on the Eastern side of the Aberdare are (Gachene, C.K.K. and Kimaru, G., 2003, in http://www.infonet-biovision.org):

- *Andosols*: young volcanic soils, found on areas with steep slopes -hence highly susceptible to erosion- and high-rainfall - hence exposed to excessive leaching. They are porous, have a high water-storage capacity and a low bulk density, and are acidic due to the high leaching of soluble bases and to the high levels of aluminium. Liming and fertilizers are necessary to improve agricultural production (typically for tea, pyrethrum, temperate crops and dairy farming);

- *Nitisols*: found on steep slopes, at lower altitude; they are developed from volcanic rocks and have better chemical and physical properties than other soils: they have a good moisture-storage capacity and aeration; the organic matter content, the cation exchange capacity and the percentage base saturation range from low to high. They are usually acidic due to the leaching of soluble bases. They often have high clay content. As the best agricultural soils found in the region, they are intensely used for plantation crops and food production (e.g. banana, tea and coffee). For optimal agricultural production, they need the use of manure and inorganic fertilizers; their protection from erosion is essential.

These soils are less commonly found on the Western side of the Aberdare, where drier climate and proximal rock basement may change the conditions of soil genesis. Meanwhile, on very gently undulating to flat topography, vertisols may occur (locally in Kinangop plateau and successive plains).

- *Vertisols*: these "black cotton" soils are characterized by a high clay content in the subsoil (higher than in the top-soil), constituting an impermeable layer resulting in a very slow vertical and poor horizontal drainage. Strongly cracking in dry season (and swelling in rainy season), dark coloured (organic matter trapped) they have an extremely poor workability and may constitute a limiting factor in tree planting.

3.2.3. Socio-economic traits

The population of the Aberdare region is rural at more than 80%. The working force is composed of a majority of agriculturalists most of whom are Kikuyu who practise mixed farming (food and cash crops along with dairy). Maasai pastoralists and their livestock, seasonally occupy the parts of Eastern side of the range, and notably the Kikuyu escarpment.

The population, living around the national park and forest reserves of the Aberdare range, and constituting a large part of the Central province is distributed as follows in **Table 2** per district.

Table 2: Population of the Central Province per district

Districts	Population	Area (km^2)
Kiambu	744 010	1324
Maragua	387 969	868
Muranga	348 304	930
Nyandarua	479 902	3304
Nyeri	661 156	3356
Thika	645 713	1960
Total	**3 267 054**	**11 742**

Source: 1999 Census of Kenya

It shows the high density of this population, 278 inhabitants/km² 10 years ago, with densities of 450 to 550 in the districts of Kiambu, Maragwa and Murang'a. In 2009, these densities may lie between 600 and 700 (Province density being assessed at around 350).
This demographic trend is to be translated into an increasing pressure on agricultural land and forests, and trade offs to be found between the conservation of the natural resources and the food, energy and water security issues for the livelihoods of the population, and accordingly the sustainable development of the Aberdare region and areas depending on its water tower.

3.2.4. Agro-ecological zones and land use in the Aberdare

According to the classification of Agro-Ecological Zones (AEZ) established by the Soil survey of Kenya (Sonbrock W.G. *and al*, 1982), the Aberdare range –including the national park area - fits into 3 main zones:

- *Zone 1 - Humid* : where R/E (annual rainfall/annual potential evapotranspiration, in %) is > 80, notably suited to tea and sugar cane (more than 50% of the area)
- *Zone 2 - Sub-humid* : where R/E varies from 65 to 80 %, notably suited to pyrethrum, potatoes, cocoyam, banana (about 20% of the area);
- *Zone 3 - Semi-humid*: where R/E varies from 50 to 65 %; notably suited to coffee, pineapple, wheat, barley, beans (about 30% of the area).

Few pocket areas, like on the extreme Southern part of the range (Kikuyu escarpment) fits in the Zone 4 - Semi-arid, where R/E varies from 40 to 50% (suited for sisal, certain grains, millet and sorghum, etc).

Although rainfall and soil fertility are unequally distributed along the Eastern and Western slopes of the Aberdare range, they are relatively high and agriculture is the dominant land use. Mixed farming (dairy cattle, food, and cash crops) characterizes this highly productive agricultural land. And due to the intensification of the farming systems, almost all villages have a water Project from the forest using gravity.

Land use in the Aberdare range and the upper catchments of its main rivers can be classified according to the following zones (adjusted from KENGEN, 2008, Nganga *et al* 1990, and FAO, 1998 **(see Maps 4and 5).**

3.2.4.1. The National Park (NP)

Altitude, 4000-2500 m: sub-alpine and alpine moorlands, at highest altitude, mainly in the central part of the range (*Erica spp*); close-canopy forests of *Hagenia abyssinica* and *Hypericum keniensis* reach the "timberline" at 3300 m, preceded at lower altitude by *Cassipourea malosana*, *Juniperus procera, Olea Africana and Podocarpus falcatus*, and dense areas of bamboos ((*Sinarundinaria alpina*), on Western and Southern parts and extending largely to the forest reserve; bamboo plays a major role in soil and water conservation and the maintenance of the water catchment. This zone of the NP is well protected thanks to its total fencing achieved in September 2009 by the Rhino Ark fence Project (about 400 km). The national park (76,700 ha, versus 57,220 ha at its creation) is home to 778 plant species (Schmidt, 1991) and is particularly rich in primates and other mammals, specific to mountain areas, and in birds (270 species).

3.2.4.2. The Gazetted Forests

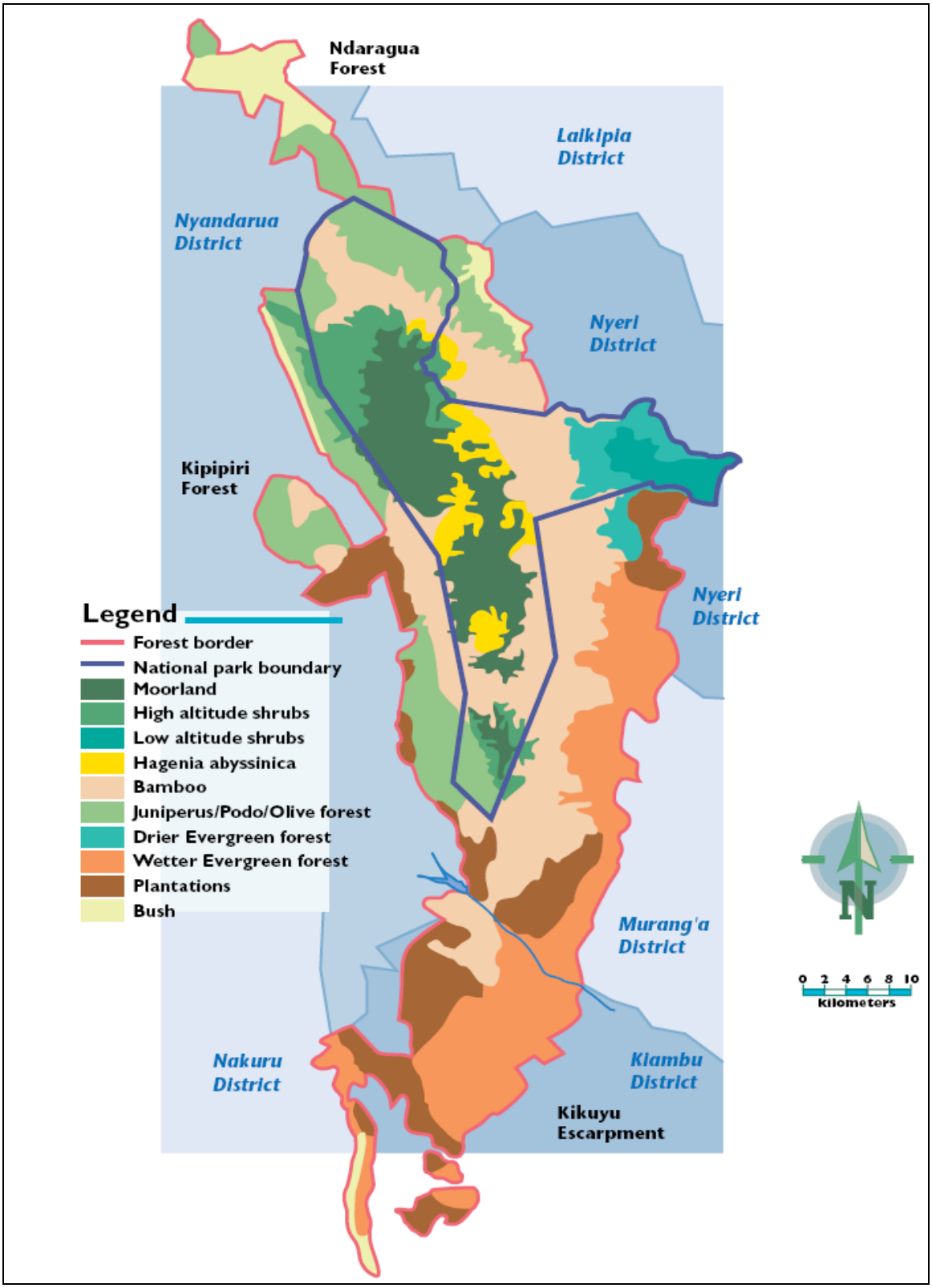
Altitude 2000-2500 m : higher elevations include most of Kenya's densest and multilayered tree cover, but forests are locally much degraded, notably in its Southern part (Kikuyu escarpment)

and its Eastern/lower and drier part (logging, charcoal, farming, grazing…). Bamboos still cover large areas on the Eastern side, whereas *Macaranga capensis* dominates the wetter evergreen forest in the South-Eastern and most humid part of the Aberdare – *along with Ocotea usambarensis and Cassipourea malosana. Juniperus procera* is one of the dominant species of the drier South-Western side. Although these forests still maintain a fairly good ground cover through secondary growth, this gazetted area decreased by 20% (from 122000 ha in 1943 to 99265 ha in 2008); erosion is low to medium and most rivers exiting the forests are relatively clean.

3.2.4.3. The Tea-Dairy zone

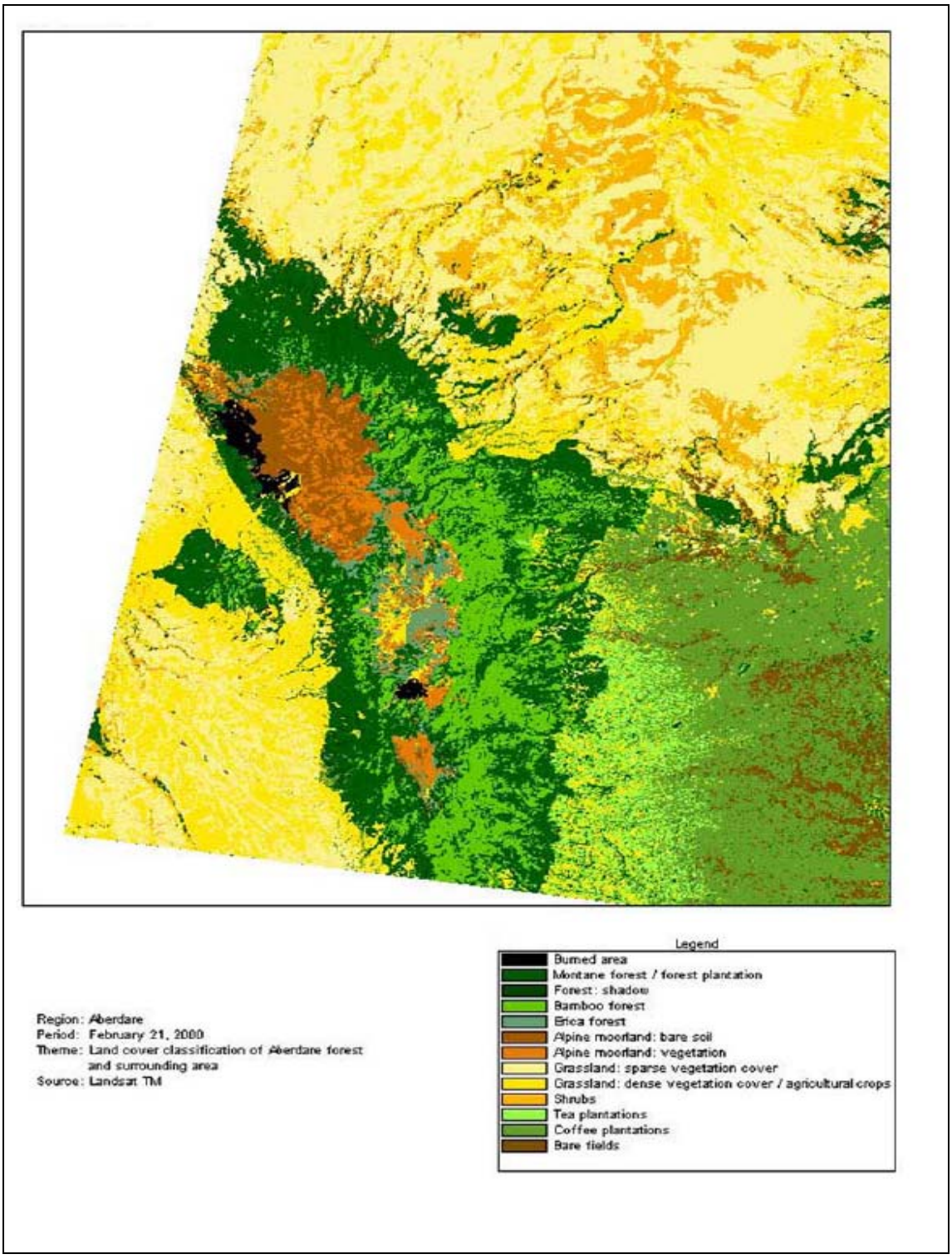
Altitude 1800- 2300 m : steep to very steep valley sides, high rainfall; tea which extended at the expenses of the forest, is dominated by small scale farmers, co-existing with big estates; erosion is low to medium with tea acting as a good ground cover; other crops include: napier grass (*Pennisetum purpureum*) for dairy on contour lines or small plots, some maize and bananas subsistence; important tree cover locally in agroforestry systems (Grevillea based, notably on the Eastern slopes of the Aberdare) along with small woodlots (eucalypts dominant, and black wattle/*Acacia mearnsii*); woodlots on the Eastern slopes of Aberdare may represent more than 10% of the cropland cover (Upper parts of Maragua and Murang'a constituencies, in relationship with the need in fuelwood of tea factories). Development of valley bottom horticulture with apparent problems of erosion along the river banks, locally (deforested, or insufficiently protected).

Map 4: Vegetation of the Aberdare range



Source: FAO Aberdares Environmental Impact Assessment Report 1998

Map 5: Land use in the Aberdare Region



Source: Endeleo Newsletter No. 2, April 2008

3.2.4.4. The Coffee-annual crops zone

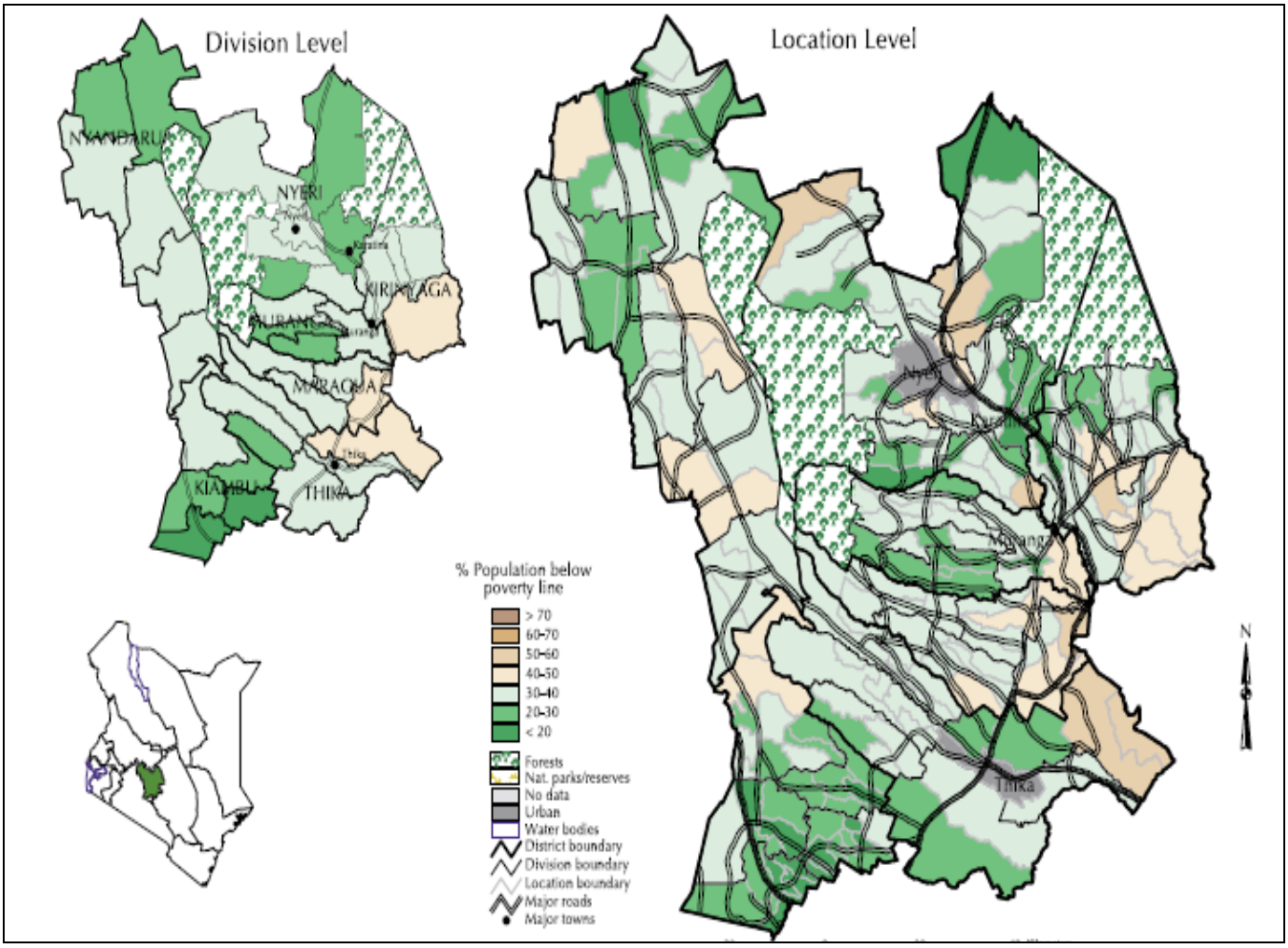
Altitude 1300-1800 m : the largest zone covering moderately steep to steep slopes, with annual rainfall varying according to wind exposition: from 1200 to 1800 mm on the Western side, windward, where rivers incised into deep soils, to 1000 to 1500 mm on the Eastern side, leeward. Small scale farming is dominant (farms of 1 to 2 acres, with subsistence crops such as maize, beans and bananas, and small plots of coffee –locally poorly managed or abandoned (low profitability), with high erosion resulting (sheet or gully type). Tree cover may reach 20 to 30% with many trees planted in agroforestry systems, commonly with *Grevillea robusta* aligned on plot boundaries, or on contour lines and terraces, and fruit tress usually scattered within the plots or planted in homesteads; these many trees contribute in reducing soil erosion and maintaining soil fertility; they also facilitate water infiltration and retention, and finally they provide 30% to 50% of firewood needs of the households. Napier grass (*Pennisetum purpureum*) and dairy farming, largely based on zero grazing (cut and carry system), are part of these agroforestry based landscapes - although less commonly found in the drier part and less fertile sides of the Aberdare, South Eastern and Kikuyu escarpment. On this escarpment and by the end of the dry season, Maasai's livestock is largely found in forest areas and adjacent bush lands where overgrazing and trampling may severely affect the soil and the vegetation (end of the dry season).

Although farmers in the Central province are not among the poorest in Kenya, the poverty line - KShs 1240/ month as per CBS estimation (WRI, 2007) - reaches 30 to 40% of the rural population (see **Map 6**). It is worthwhile to note that the economic benefits of the Aberdare for forest adjacent households were estimated as USD 165 per household per year in 1998 by Emerton *and al*; and this contributes somehow to rural poverty alleviation.

3.2.5. Forest threats and management in the Aberdare range

- Forests and tree plantations in Aberdare cover about 148,000 ha, against 181,594 ha in 1943 when first gazetted. Forest area is actually part of the larger Aberdare forest ecosystem, including: the forest reserve (99,265 ha), the Kikuyu escarpment (36,335 ha), and the Kipipiri Forest reserve (3,900 ha) and the national park (76,700 ha) – viz. a total of 216,200 ha. According to the feasibility study (AFD/BRL, 2006) the breakdown is as follows (in gazetted forests, excluding the NP).

Map 6: Central Province percentage population below the rural poverty line



Source: Central Bureau of Statistics, Geographic dimensions of well being in Kenya, 2003

Table 3: Vegetation types in Aberdare gazetted forests

Vegetation type	Surface (ha)	Surface (%)
Indigenous natural forests	51,972	36
Plantations of exotic trees	24,125	17
Bamboo	45,970	33
Bushland	11,073	8
Grassland	8,062	6

- These components are the ground for the Aberdare Forest Ecosystem Integrated Management plan to be set up soon, in the framework of the Forest Act, 2005 and it's on going application.

- Forest excision and encroachment, as observed in Geta forest, are considered as major problems by the KFS.

- More precisely, the aerial survey carried out by UNEP *et al* in 2002 shows an important level of destruction of the Aberdare range forests (**see Map 7).** The forest ecosystem surrounding the National Park appears highly endangered by illegal activities: charcoal production, tree logging, cultivation and overgrazing.

  On the Southern slopes, the most affected part of the Aberdare range: over 10,000 temporary places of charcoal production were counted within the mixed broadleaf forest, and about 80% of the forest canopy in most parts of the Kikuyu Escarpment was depleted, both by charcoal making and tree logging; grazing is another major threat as over 5,700 heads of cattle were counted at that time.

  On the Western slopes, logging and charcoal production impacts similarly the forest, whereas about 4500ha of forest land around Kipipiri and 1100ha in Ragia forest appeared converted into crop plots -including cannabis cultivation.

  On the Eastern slopes, logging and illegal cultivation are the dominant threats; the study reveals that clear felled forest plantations under the Shamba system were not replanted with young trees - hence questioning its efficiency.

  At the date of the Feasibility study (2006), the degraded forest to be rehabilitated in 6 initially targeted districts for the Project was estimated at 6,930 ha.

  Fires are not rare in the Aberdares, resulting from uncontrolled management practices (notably pastoralism, bee keeping, and charcoal making) and arsonists. On average, hundreds of hectares of forest burn every year, notably affecting the Central and Western to Southern sides of the range; bamboo is one the species highly susceptible to fire.

  As a result, forest areas and habitats in the Aberdare range are locally highly fragmented, and many tree species (and most probably animal species) are vanishing. Among them are the Camphor tree (*Ocotea usambarensis*), the Cedar tree (*Juniperus procera*) and the African Olive tree (*Olea africana*). In addition to their drastic effects on biodiversity and genetic resources, the ongoing assault on these forests poses grave

threat to Kenya's water security, along with climate regulation and economic development.

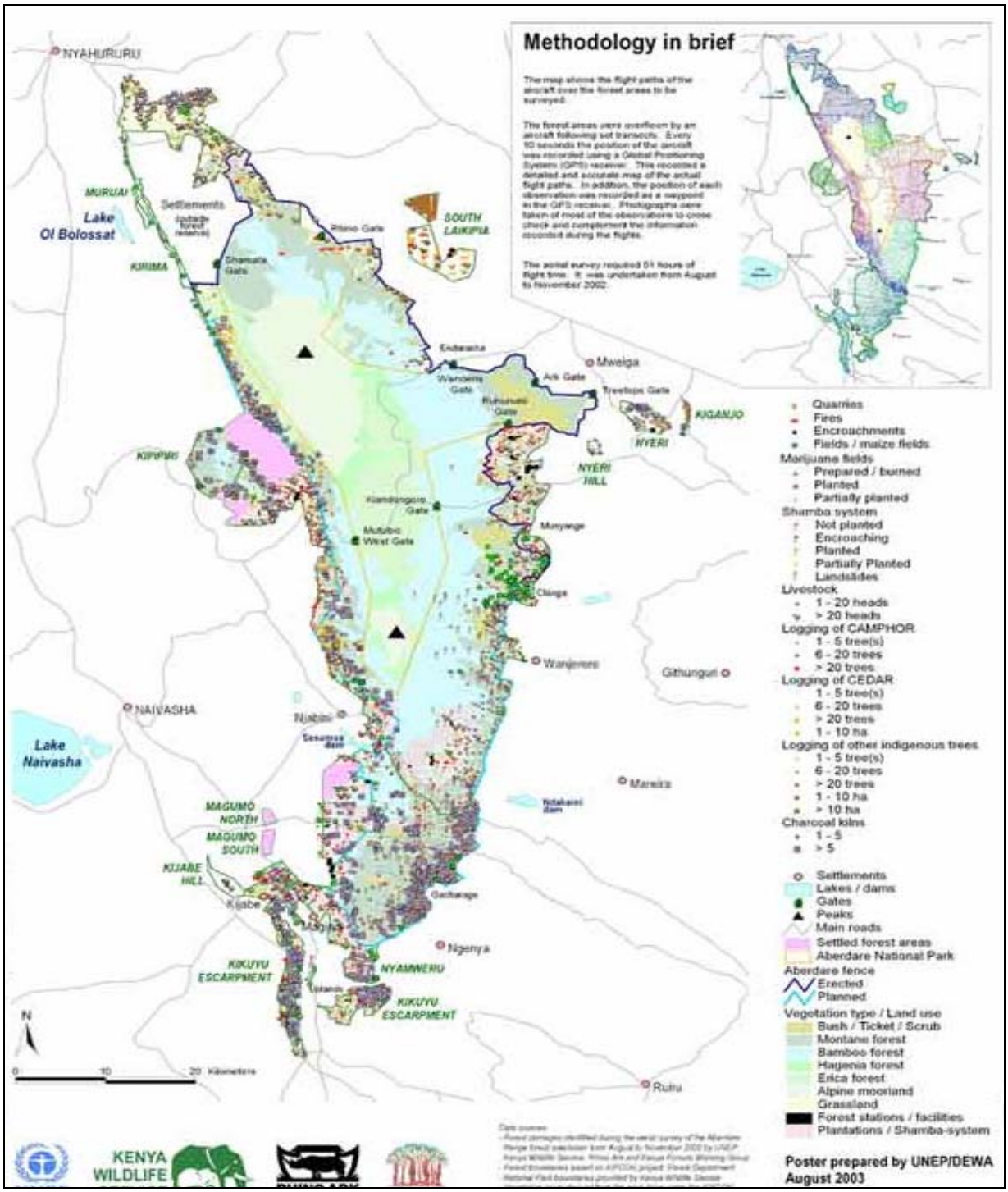
- Hopefully, the recent erection of electric fences around the national park and the gazetted forest should reduce the threats on that water tower and permit the progressive reconstitution of the natural environment. Planting indigenous trees inside the fences should be a good opportunity to accelerate the reconstitution of the native forests and GBM contribution, through its AFD funded Project and others dedicated to re-forestation of the Aberdare range, is essential.

- Besides the degradation of that mountain environment, the comparative aerial views of 1987 and 2002 of the Aberdare range shows some extension of tree planting in farmlands **(see Map 8).**

3.2.6. Aberdare and wood production

Although the area under tree plantation is low in Kenya (about 120,000 ha), the Aberdare, through KFS plantations of exotic species in Gazetted areas (pines and cypresses, mainly, and eucalypts) could provide an important part of the timber production in the country; their development and moreover a better management should allow the reduction of massive and costly importation of timber from other countries and the pressure on the forests.
Since the total ban on timber harvesting imposed in 1999 – due to an increase in the exploitation of the plantations by non-licensed operators - and the closure of hundreds of saw-mills installed close to the Aberdare forest (and departure of their employees), many mature plantations remain unharvested. This represents an important loss of wood (30 000 ha of over mature plantations deteriorating) and income for KFS and the country (value of imported wood reached 3 billions KShs in 2008).
Consequently, pressure on trees in farmlands and illegal cutting of wood continues unabatedly in gazetted forests and plantations.

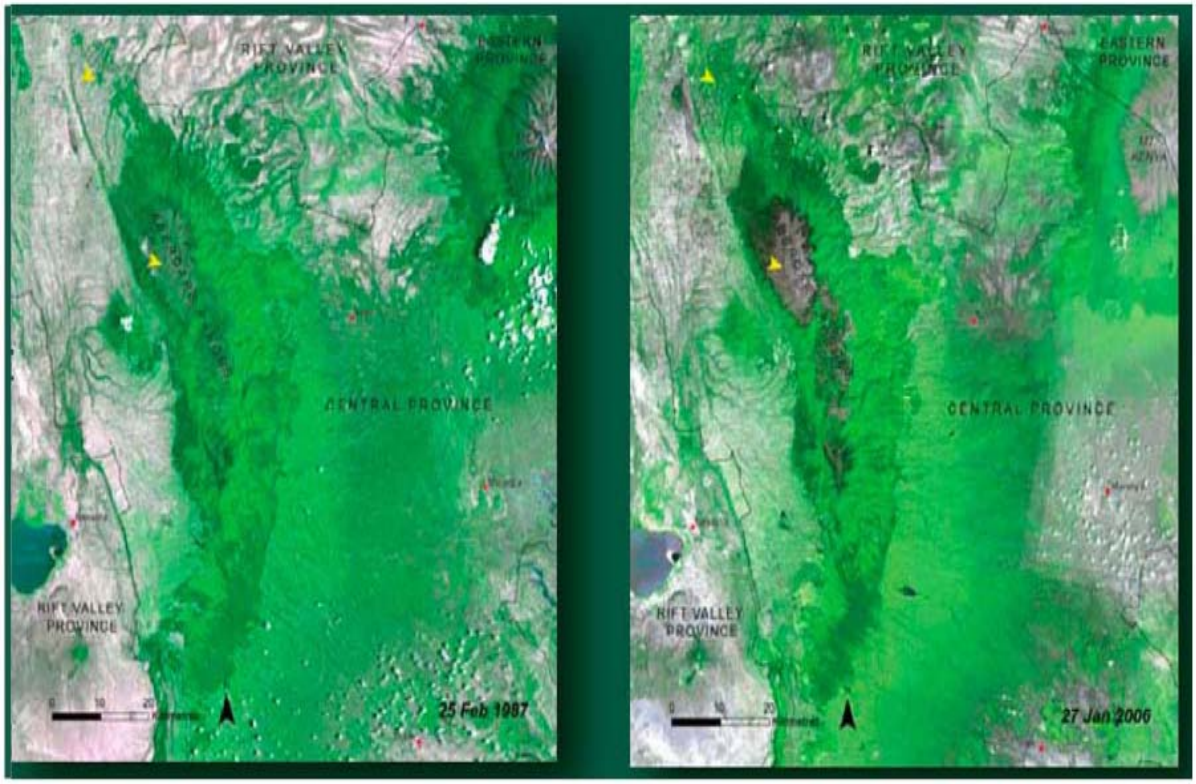
Map 7: Aerial Survey of the destruction of the Aberdare Range Forests



Source: UNEP *et al*, Aerial Survey of the Destruction of the Aberdare Range Forests, 2003

Map 8: Extension of tree planting in farmlands and land use evolution between 1987 and 2006

1987 **2006**



Source: Google Earth

3.3. International and national legal frameworks

Law, international as well as national, is central in the regulation of resource management. It prescribes rules for resource use and makes provision for implementation and enforcement mechanisms (Kameri-Mbote, 2002).

3.3.1. International Conventions related to environmental issues

In regards to the objectives of the Project and its location in the Aberdare range, it is important to remember that Kenya has signed all of the major international agreements on or related to the preservation of the environment –of which the Convention of Biological Diversity (CBD), the UN Framework Convention on Climate Change (UNFCCC) and the Convention on International Trade in Endangered Species (CITES).

3.3.2. Kenyan policies and reforms and their meaning for the local communities

3.3.2.1. The Forests Act, 2005, and its implementation through PFM

The previous Forests Act (cap 385) allowed the degazettement of forests by the Minister without any consultation, apart from a 28-day notice; this was used to reduce the forest areas with forests being converted to human settlements and agriculture (large excisions, based on strong political interference –for example Mau forests).

The new Forests Act, 2005, rolled out for implementation on 1st February 2007, addresses the national and global challenges that could not be addressed in the previous Act, notably the management of non State/gazetted forests, and moreover the participation of local communities and other stakeholders in forest management. This new Participatory Forest Management (PFM) approach is to be applied through memorandum of agreement between Community Forest Association (CFA) and KFS and ad hoc forest management plan.

8 basic steps summarize the PFM process:

1. Identifying the community and verifying resources
2. Assessing forest area and the community
3. Preparing draft forest management plan
4. Facilitating the formation of local forest associations
5. Negotiating, drafting and signing a forest management agreement and to declare the area a PFM area
6. Implementing the plan (and preparation of annual work plans)
7. Reviewing and revising the plan on the basis of the experiences
8. Monitoring and evaluation on the process.

Formation of Forest Conservancy Areas (FCA), based on an ecosystem approach, and establishment of corresponding committees (FCC) constituted the first step for implementing the Forest Act. Central region, among others, has its FCC who will manage the Conservancies (divided into Divisions and themselves subdivided into about 200 Blocks). Forest Management Plans have been prepared for various areas including the Aberdare and

developed with the local populations (registered CFA they constitute) into Participatory Forest Management Plans (PFM).

GBM, through its own networks, and natural links with CFA is involved in the preparation of certain PFM.

In this perspective, which requires the full contribution of all stakeholders, training and capacity building, as well as forest resource assessment (inventories, and baseline information are drastically missing) and important financial support remain to be initiated or mobilized to boost the process.

It is important to note that CFA do not qualify to any commercial enterprise, such as sawmilling (if the ban on logging in forest plantations is lifted); and this limitation to "social welfare" activity questions the benefits sharing and the success of PFM.

3.3.2.2. The Water Act, 2002, major changes and expectations

The reform of the water sector led notably to: the separation of the management of water resources from the provision of water services (now under a Water Services Regulatory Board), and of water and sanitation from the management of water resources, the decentralization of functions to lower level state organs (7 regional Water Services Boards) and the involvement of non-government entities in the management of water resources as well as in the provision of water services. An autonomous Water Resources Management Authority (WARMA) was established, to manage and protect Kenya's water resources.
Representatives for the new Area Catchments Advisory Committees have been selected and the Water Users Associations are now encouraged to define their new roles.

At the strategic level, the goals of the National Water Services Strategy (NWSS, 2007) which refers to MDG goals, include the need to reach at least 50% of the underserved in rural areas with safe and affordable water by 2015 and thereafter move to sustainable access for all by 2030, and similarly the underserved urban population.

Meanwhile, at the level of its implementation and according to Mumma (2005), the Act marginalizes collectivities, such as poor rural community groups in the acquisition and exercise of the right to use water resources. This could undermine the ability of poor rural communities in Kenya to effectively utilize water resources in economically productive activities such as irrigation and commercial livestock rearing given, in addition to the limited technical and financial support the Government of Kenya could provide in such enterprises.

3.3.2.3. Land agriculture and wildlife policies and acts, and property rights

Policies on land tenure, land use and wildlife show many discrepancies or in the least are little harmonized. Nevertheless, biodiversity conservation and wildlife management directly question property rights notably farmers' rights, in and out of reserve areas and land use and tenure issues.

Land rights, registration and title, in Kenya are complex, being governed by Government Lands Act and the Registration of Documents Act, and the Registration of Titles Act and the Registered Land Act (RLA) – with the expectation of bringing all land under one law.

The Agriculture Act, besides its objectives of productivity and agricultural land development, is to provide for the preservation of the soils and their fertility, thus including soil (and water) conservation measures and restrictions on (tree) vegetation clearing, grazing in fragile ecosystems (for example in mountain areas), etc – but with little effect on increasing land degradation in many parts of the country.

If policies on land tenure have close links with agriculture, they do not take into account wildlife management as a land use; and wildlife as a whole is considered as a totally separate issue. KWS, on behalf of the State, has authority to manage it, and this authority extends to both protected and unprotected areas, as ownership of wildlife found on any land is vested in the State, through KWS which may grant user rights to other parties –of which communities surrounding parks or reserves.

As cultivation and wildlife management appear incompatible land uses, the commonest reply or consideration given to local communities is the fencing of the parks or reserves, to reduce the conflicts between humans and wildlife - whereas community participation in wildlife management remains largely exploratory, or come from initiatives without legal basis. But the on going Participatory Forest Management plans resulting from the new Forest Act should allow re-launching the matter, and giving certain rights to communities living within the proximity of forests, or better associate them to wildlife and indigenous forests based activities such as eco-tourism.

Property rights can act as an incentive for sustainable wildlife (and forest) management if they are framed at the right levels and are secure.

3.4 Historical background within GBM vision and approach

The Green Belt Movement is a community-based non-governmental organisation focussing on environmental conservation, community empowerment and capacity building. Prof. Wangari Maathai, the 2004 Nobel Peace Prize Laureate, founded GBM in 1977 under the auspices of the National Council of Women of Kenya.

3.4.1 Green Belt Movement Vision & Mission.

GBM vision is to create a value-driven society of people who consciously work for continued improvement of their livelihoods and a greener, cleaner Kenya. It aims to mobilize community consciousness for environmental conservation, self-determination, equity, improved livelihoods and governance, and to promote culture of peace. This vision is achieved through the respect of nature, and through the protection and rehabilitation of the environment using tree planting as an entry point.

The GBM core values are: Voluntarism for community benefit, Demonstrable love for the environment, Self-betterment, Accountability, Transparency and honesty, Self and community empowerment and Pro-active approach to self and community development.

3.4.2 GBM Approach

GBM has inherent experience of 32 years mobilizing and leading communities in Kenya to take action and plant trees.

3.4.2.1. GBM Phase 1 (1977-1997)

GBM phase 1 focused on planting trees on farms with women. Each group had a nursery on which it raised tree seedlings. Over the years, the methodology used in establishing a tree nursery has been improved, resulting in the 10 steps procedure as given in Figure 1 (For full details , see **Appendix 6**).
GBM Phase 1 was a notable success. During that period, communities learned the benefits of trees on farms in terms of direct material benefits and environmental conservation. They have also learned skills of raising tree seedlings and planting them; so that people could now by themselves continue to plant trees on their farms. Nevertheless, most of the trees planted were exotics (notably *Grevillea robusta*) and fruit trees, which yield high, immediate material benefits but possibly lower environmental conservation benefits. Comparatively, indigenous trees are reported to have delayed material benefits
but higher environmental conservation benefits. Communities avoided planting these indigenous species on their farms because of too slow growth and, for some of them, because of their large canopies that take too much space on the farm.

3.4.2.2. GBM Phase 2 (1998 – until now and future)

The Program (Phase 2), "Tree planting on public lands", aims at moving tree planting to public places: forests, parks, along streams, road reserves, and other open green spaces. It would raise environmental consciousness to a new level.

This phase of the program focuses on the planting of indigenous trees on public lands to enhance the impact of environmental conservation and in forest catchment areas and riparian reserves to preserve local biological diversity. The same ten-step procedure is followed in this phase.

To compliment this strategy, individuals and groups are encouraged to continue planting both exotic and indigenous trees on their farms. Although GBM no longer compensates for these trees (on private spaces) the groups are encouraged to commercialize their tree nurseries for financial gain.
The major changes to Phase 2 therefore involved the shift from private to public lands as the focus for the conservation campaign, and an increase in the monitoring and protests against the grabbing of public land, destruction of forests, poor governance, abuse of people's rights, and atrocities such as tribal clashes. Although some of this was already going on in Phase 1, it was not a focal area.

Figure 1: The GBM 10 steps procedure - summary

1- GBM staff members along with the field facilitators conduct sensitization and mobilization seminars to disseminate information on the importance of tree planting based on GBM goals and values. These seminars are open to anyone. Then, individuals are invited to form groups to register with the GBM Kenya.

2- GBM Kenya field facilitators assist interested persons in the formation and registration of groups.

3- Groups register as members of GBM. This officially opens up communication and follow-up with the groups and GBM staff.

4- Once registered, the groups receive assistance on the preparation of tree nurseries and seed sowing. The group members collect seeds (indigenous, fruit, and exotic tree species) from the forest and plant them in their nurseries. GBM Kenya provides some initial seeds to get the groups started.

5- Once trees begin to grow, they are transplanted into individual containers or plastic bags. Green Volunteers assist groups with the writing and submission of monthly reports to headquarters. The reports contain information on the status of the nursery (numbers of trees: exotic, fruit, indigenous), the numbers that are ready for distribution, and any challenges facing the nursery.

6- Once seedlings are ready to be distributed, the groups ask those interested to dig and prepare the planting holes to make sure they are actually planted.

7- Group members check the holes to ascertain they are properly dug prior to supplying seedlings (2 feet deep and wide, manure applied to holes when soil is poor).

8- Once holes are approved, seedlings are supplied and the report of seedlings distributed sent to HQ in the monthly report. A partial payment for the seedlings is made to the group by GBM. This payment is a small incentive in recognition of the work the women have put into raising the seedlings.

9- Group members conduct the first verification of seedling survival at 1 month and that information is sent to HQ.

10- A second verification of the same trees is conducted at 3 months and likewise that information is sent to the HQ. If reports are acceptable GBM purchases the seedlings from the groups. By so doing, the groups get a small compensation for the number of trees surviving at the time of the second follow-up. It is also understood that survival of the trees is significantly increased if they survive the first 3 months.

In phase 2, the preferred tree species vary depending on the purpose; see **Table 4**.

Table 4: Best suited species planted according to the purpose and the planting site, in GBM tree planting, Phase 2

Purpose	Best suited species	Primarily planted in	Secondarily planted in
Environmental conservation	Indigenous	Public places	Farms but sparsely
Household needs	Exotics (fast growing)	Farms	—
Fodder	Exotics (fast growing)	Farms	—
Medicine/Herbs	Indigenous	Public places	Farms
Food security	Exotics & Fruit trees	Farms	Public places
Shade	Indigenous	Farms	Public places
Increase biodiversity	Indigenous (to support birds, animals & plants)	Public places	Farms
Protecting cultural sites	Indigenous	Public places	—

Source: GBM/AFD Project

The GBM/AFD Aberdare Reforestation Project is part of that second phase, still strongly based on community approach, but focussing on watershed conservation issues and therefore public (forest) lands.

3.5 The GBM/AFD Aberdare Reforestation Project

3.5.1. Setting up and funding

The Project was initiated in 2006, through the French Agency for Development (AFD) funding.

The kick off process for the Project was highlighted by a feasibility study conducted in May 2006. The study reviewed the Phase 1, the successes and challenges and consequent lessons that could advice the design of Phase 2 in general and in particular in designing the AFD Project. Consequently, the study set out a proposed design of the AFD Project, defining the objectives, outputs and activities, indicators and monitoring process, as well as the broad financing and administrative interfaces. The Project management has tried as much as possible to implement according to the design set out in the feasibility study.

Initially, a Program Officer was deployed for the Project, however, he left the Project in 2007, and his responsibilities were temporarily taken up by the Program Manager. After a short period, the current Project Officer was engaged in 2008, and she took up the full Project implementation responsibilities.

The total funding of the Project is 2,105,000 €, set out as follows **(see Table 5).**

Table 5: Funding of the Project, as per contributions and components

Contributors , amounts in € **Components**	**AFD**	**Communities, in kind**	**GBM**	**Total**
1. Rehabilitation of the Aberdare forest ecosystem in the public lands	600,000	690,000		**1,290,000**
2. Public and institutional awareness –dissemination & communication	180,000			**180,000**
3. Project monitoring and management	470,000		115,000	**585,000**
4. Contingencies	50,000			**50,000**
Total	1,300,000	690,000	115,000	**2,105,000**

Source: AFD/BRL, Project Feasibility Study, 2006

From the table above, it can be seen that the total AFD funding comprised € 1,300,000 or 61.7% of the Project. GBM and Communities contributions are 5.5% and 32.8%.

The Project is managed by the Green Belt Movement, according to well defined financial rules of disbursement of funds, procurement and reporting to the Donor (Implementation manual and rules of procedures, GBM 2206, revised 2009).

3.5.2. Location of the Project

The area covered by the Project is shown in **Map 9** below: it covers 13 constituencies of the Central Province (referred as such at the starting time of the Project, before the recent upgrading of constituencies to districts), viz:

- 5 on Western side, from North to South: Kipipiri, North Kinangop, South Kinangop, Lari and Limuru; whose delineation broadly follows the North-South alignment of the Aberdare range along with the Eastern escarpment of the Rift Valley;
- 8 on Eastern side, from South to North: Githunguri, Gatundu South, Gatundu North, Gatanga, Kigumo, Kangema, Mathioya, Kiharu; whose delineation, is broadly West - East (to South-East), results from the slope orientation and the way the rivers flow.

The Project focuses on the Eastern and Southern sides and part of Eastern slope (below Nyeri District) of the Aberdare range, viz. in contrasted areas from a bioclimatic point of view, and densely to very densely populated areas presenting a large variety of threats to forests and rivers, and, as a whole, multiple and complex problems of land management.

3.5.3. Project rationale

To restore underground water reservoirs that feed streams and rivers, natural forests must be rehabilitated through active indigenous tree planting and protection from cultivators, livestock grazers, charcoal burners and loggers.

The pressure on forests negatively impacts on sectors like agriculture especially irrigation and horticulture, energy which loses capacity to produce hydropower from downstream dams, livestock, fisheries and tourism. All these sectors are important for the economy and the capacity of the country to address the Millennium Development Goals (MDG).

For this reason, GBM has shifted its emphasis from private farms and now promotes rehabilitation of degraded natural forests and other public lands, which serve as water catchment areas. It encourages its community groups to plant indigenous trees in these ecosystems.

3.5.4. Project objectives and expected outputs

The overall goal of this Project is to restore the degraded areas of the Aberdare forest ecosystem to improve its functions (mainly water and biodiversity conservation) and improve the livelihood of the local communities adjacent to the ecosystem.
In order to articulate these broad objectives several specific objectives were developed:

- To rehabilitate degraded forest areas by replanting local species, this will continue to maintain hydrology, the soil and the biodiversity of the forest.
- To support and diversify, in a sustainable manner, the sources of income of the neighbouring populations of the forest by generating income from plantation activities and promoting an alternative and profitable use of the forest.
- To promote protection initiatives for the forest by the civil society (NGOs and women groups).
- To create conditions for replication of a pilot Project for total rehabilitation of the forest basin slope.

This Project was to rehabilitate 2000 ha of degraded sites within Aberdare range. The targeted constituencies include Kinangop, Lari, Kigumo, and Gatanga constituencies.
However, after a careful analysis of the Aberdares range it was found that other sites that also form an important part of the watershed in consideration were left out and there was a need to include these areas. Furthermore it was envisaged that covering a wider area would spread the benefits to more community groups and thus empowering more people. Still, this would lead to a more complete ecosystem restoration since the areas added are sandwiched within the original target constituencies and thus this would create continuity through landscape linkage. Thus, the target sites were expanded to include 8 more constituencies namely;

Kipipiri, Limuru, Gatundu North and Gatundu South, Githunguri, Kiharu, Kangema and Mathioya **(see Map 9** and **Appendices 16 and 17).**

In addition, public sites and road reserves were also included for tree planting since this would not only contribute to the watershed conservation but would lead to improvement of water quality by reducing soil erosion. This would also deflect the pressure from the forests by offering alternatives for fuel wood as well as fodder for domestic animals. Still, the trees planted would be important as "stepping stones" for forest birds and agro-ecosystem biodiversity such as seed dispersers (birds) and pollinators (butterflies and bees) that offer crucial services to agriculture and the environment.

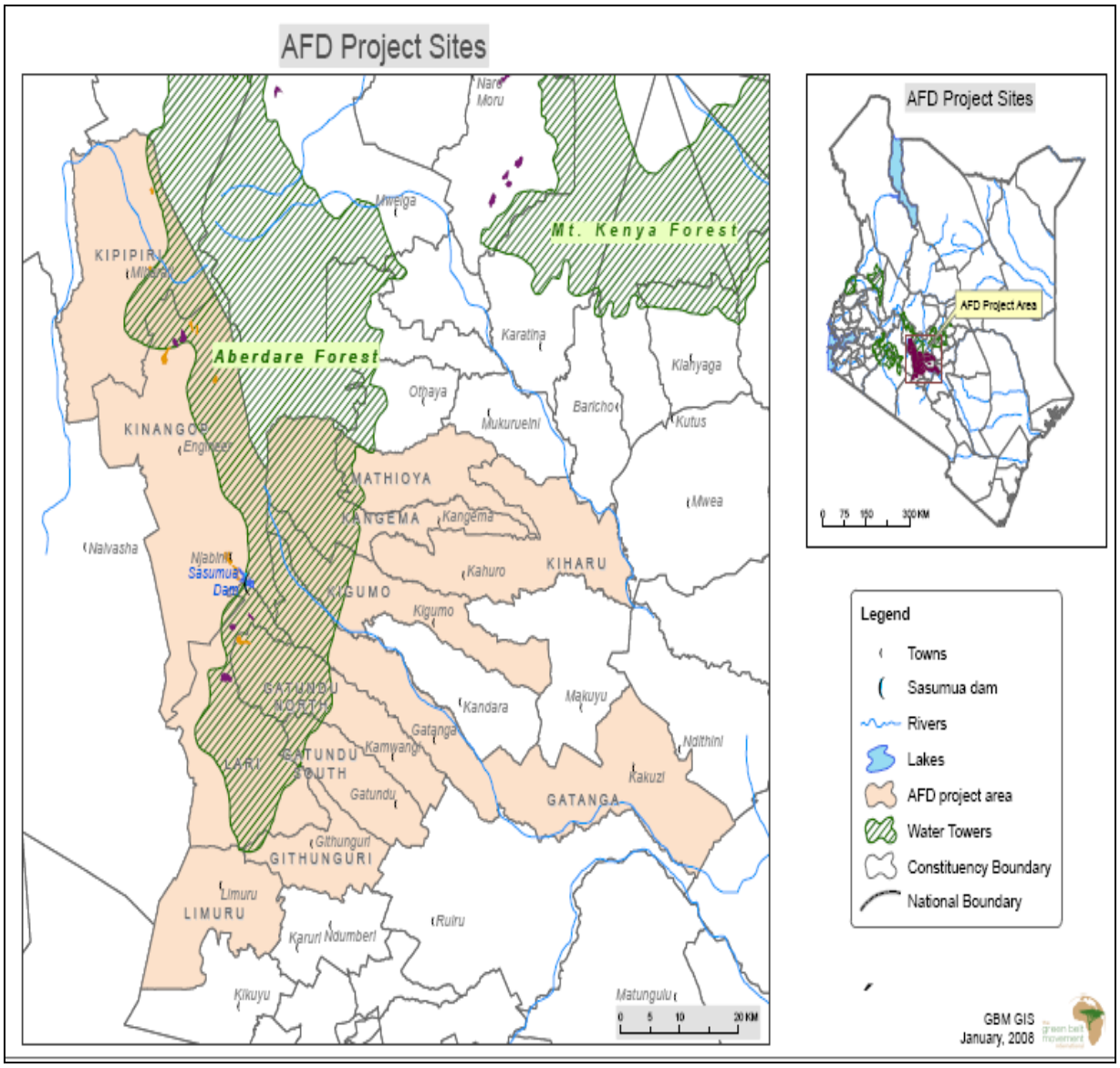
In summary, the Project should act through *women groups*, contribute to the *rehabilitation of degraded forests* by planting *indigenous tree species*, support and diversify *livelihoods* of communities; *disseminate forest protection initiatives*, and create the conditions for *replicating a pilot Project* for full rehabilitation of such watersheds.

The Project is to be implemented in two "components": two methodological and technical components (1 and 2), in addition to two other components of Project monitoring and management and contingencies (3 and 4).

Component 1: Rehabilitation of the degraded forest ecosystem of the Aberdare forest ecosystem in public lands.

The target is to replant and protect 2,000 ha (3,400 ha if additional funds are available) with indigenous tree species into the Aberdare Forest Reserve. This program will engage the local communities (especially women groups) and the Forest Services in practical actions that will promote good environmental management and governance of forest resources. The Project will include (i) the communities and stakeholders mobilization and education, (ii) the GBM member groups and foresters training, (iii) the general planning with the FD, (iv) the production of 4 million seedlings in 280 community-based tree nurseries, (v) tree planting and nurturing and, (vi) survival follow up. The community member groups will be compensated for each surviving tree and encouraged to reinvest the compensation into alternative sustainable livelihoods. Additional seedlings can be used by the farmers for planting on their lands.

Map 9: Area and constituencies covered by the Project



Source: GBM GIS Unit January 2008

***Component 2*: Public and institutional awareness and dissemination and communication**.

The target is to mobilize the civil society and its leaders, at the local and national level, to support good governance of watershed catchments forest resources. It aims to create awareness among the communities for a sustainable forest management, to promote environment friendly and sustainable forest management policies and to disseminate the outcomes of this Project throughout the remaining four water towers and beyond. The component will support (i) local and national lobbying and mass education, (ii) design and dissemination of specific studies for advocacy (relevant policies, hydrology, alternative livelihoods), (iii) design of a video document and a website and, (iv) GBM-FD workshops with other water towers for sharing of experience.

The logical framework of the Project, with its objectives, expected outputs and indicators, is summarized in **Appendix 8.**

PART 2: PROJECT DIAGNOSIS, ORGANIZATION AND MANAGEMENT

4 Organization and management of the Project at its different hierarchical and operational levels

4.4 Current Project staffing and organization

4.4.1 Head of Project

The Project is carried out by Mercy Karunditu, a Project officer with an MSc in Agroforestry and Rural Development who took this position in February 2008, two years after the Project started; the Project was initially implemented by Philip Wamahiu, Programme Officer (2006-07), and Jasper Kirika, Programme Officer (2007-08), this important staff turnover reflects the difficulty the Project had at its beginning with effect on its development and expected progress.

4.4.2. Downstream at field level

4.4.2.1. Extension Officers, Green Rangers and Green Volunteers

The Head of the Project directly interacts with twelve Extension Officers (EO), at constituency level (in addition to one Green Volunteer currently acting as an Extension Officer for the 13th Constituency. Most of them have a diploma or degree in Forestry and Environmental sciences and are young and committed **(see Appendix 9).** The EOs form the ground operational team of the organisation. They are assisted by the Green Volunteers (GV) and the Green Rangers (GR)—see list of GV and GR in **Appendix 10**. Some constituencies and sites don't have GRs because of no public lands/forests to be rehabilitated, or forest sites are well respected, or because of too high pressure of livestock or wildlife – which jeopardizes the strategy and the management of such planted sites. The GV are in charge of network of nursery groups at sub-location level and the GR provide security services in planted gazetted sites (about 10 ha are under the responsibility of a GR, who is paid KShs 3000 per month).
The nursery groups are organised at village level; they establish and manage tree nurseries and then issue seedlings for planting, as well as conducting the major planting and after care tasks.
All in all, the Project Officers are now managing coverage of 516 tree nurseries in 13 constituencies.

4.4.2.2 Local Coordination Units (LCU)

At the field level, there are Local Coordination Units (5 in total), which perform the steering role at that level. A Local Coordination Unit is made up of a GBM Extension Officer, the KFS forester in charge of the Forest Station, the Aberdare National Park senior warden, the area Agriculture Extension Officer, the local Water Officer, local leaders (e.g. Councillor).

4.4.3 Upstream, at GBM Head Quarters level

4.4.3.1. Interaction with internal GBM management and services

The Head of Project interacts with, the Chair and Founder of GBM, Prof Wangari Maathai. She reports directly to Mr. Daniel Muli, the Finance and Administration Director of GBM, recruited in 2007 through AFD support and who is also currently the Acting Executive Director (see GBM Organization Chart in **Appendix 11**)

The Project also works closely with two Project facilitators based at the head quarters and the recently established Monitoring and Evaluation cell, (April 2009, headed by Wanjiru Nderitu). It is also serviced by other technical services of GBM, such as the Geographical Information System unit (development of Projects data base), the Lang'ata training Centre for staff and network members capacity building, and the Finance and Administration. It also does share experiences with other Projects of the organisation during the Program Management meetings.

There is currently no Program Officer, but the recruitment process is said to be on going.

4.4.3.2. Interactions with various interest groups

GBM management at higher levels, does interact with various interest groups including government ministries and agencies (e.g. Water Resources Management Authority), donors (e.g. World Bank, USAID), international research institutions (e.g. ICRAF), institutions of higher learning (e.g. University of Nairobi), and in general the civil society. All these interactions contribute to provide ideas and thinking for quality dimensions in the Project.

4.4.3.3 Steering and Programs Management Committees

The Project has a Steering Committee (SC), made up of five members (GBM, AFD, KFS, KWS, Ministry of Water and Irrigation). The SC meets on notice on matters that ensure that the Project is progressing in the intended direction.
The mission could not meet members of this Committee, but from exchanges held on the matter with the donor and the Project, and minutes of meetings, it appears that:

- the SC met only on 20/11/2007 and on 07/17/2009 – this seems not enough to be fully efficient
- the SC serves more as a platform to update the members of the committee on the progress of Project implementation and challenges faced, while SC should take or boost action on various issues of policy and key Project implementation challenges
- the representatives of the SC on the part of key institutions keep changing, making it difficult for this committee to integrate institutional roles in the Project implementation and to maintain the necessary continuity
- there is no link between the Local Coordination Units (LCU) and the SC and the two groups seem to operate in parallel without interaction.

Higher frequency and consistency of the meetings, for action, more commitment from certain members of SC, and formalized links with the LCU are necessary; and this should be in the agenda of the next SC meeting.

At the management level, there is the Programs Management Committee, which meets weekly at the head office to appraise the progress of the various technical and administrative issues and to render further conceptual assistance to the Project officers. This committee is made up of the Founder, the Acting Executive Director, the Project Officers, the Monitoring and Evaluation Officer, the Finance Officer.

4.5 Framework and implementation of the Project

4.5.1. Organizational analysis and management issues

Like other GBM Projects, the AFD funded Project is based and implemented at the sub-location level (the smallest administrative unit in the country), and managed at the constituency level, the political unit of the country. This framework offers a certain advantage; for example it enables inclusivity of participants and support at the political level. However, while this advantage is appreciated, it is also noted that managing it purely according to the political/administrative boundaries may overshadow certain environmental issues the Project is expected to deal with, such as its watershed dimension: as catchments and sub catchments have obviously totally different delineation, and the two do not necessarily always overlap. Hence, the approach, may not incisively be in tandem with the given watershed oriented objectives of such a Project axed on the *Rehabilitation of the Aberdare Forest Ecosystem.*

It also appears that proposals submitted by the supervision missions to GBM Management for approval and follow up may take too long. This affects the good functioning of the Project,

and its development. As an example, the question of purchasing equipment for the nurseries has taken long, although the Project has the budget to act on this issue.

4.5.2 Proposals

Without excluding or ignoring the political units that the Project is based upon, a reflexion on the (spatial) reality of watershed concept and management should be taken into an account for the best efficiency, along with and corresponding actions for the last year of the Project (site selection, plantations, etc), and a possible second phase of it. On this we were made to understand that recently GBM has been working with The Nature Conservancy to develop a hybrid approach that combines its traditional community approach and watershed Project implementation, which is a commendable move.

To facilitate the quick address of more global issues of the Project like the watershed management concept, we feel that the recruitment of a Programme Officer, which has been scheduled for some time, but remains to be effectively done, should now be done without more delay.

4.6 Monitoring and evaluation, Project impacts

4.6.1. Control organization

The reporting of the activities of the Tree Nursery Groups, from the group creation, the nursery preparation to planting and until 24 months after planting, is based on the 10 steps method (described above) and on 12 forms that are to be filled out at any step of the programme.

The major and most visible preoccupation of GBM is engaging the communities in planting trees and it is this function that the institutions monitoring system has been perfected for. The institution starts with Form 4, which indicates that a group has formally come into the GBM fraternity after being duly registered with the Ministry of Culture and Social Services. From there, the group interacts with the GBM extension people to start a tree nursery. Through Form 5, the group will then report the number of seedlings it has raised, the species, number ready for planting and number not ready.

Through a number of other forms, the group will report places where they have identified and received approval to plant trees, digging of holes, planting/issue of trees, and follow-up of the sites, up to six months from planting when the group does its survival count. Most of these actions are done with the advice or under the supervision of the extension officers. All these forms are received and submitted to the head office by the extension officers.

Six months after planting, the extension officer then carries out verification of the survival count for the purposes of compensation to the group. Transplants' counting is done in a statistical way as described in paragraph 6.1.1.11. The verification information is sent to the office, reviewed and passed by the facilitators, to update network cards and prepare

compensation vouchers and finally approved by the Project officer for onward transmission to accounts for payments processing.

The data is also keyed into the data base system, from where it can be analyzed to give the kind of statistics the Project officer wants at a particular time. Plans are under way to link it with the GIS and financial system.

The above is quite elaborate, and very detailed information is captured. However, as noted above, this data is to do with tree planting activity up to survival count and payment. The question arises now on impact monitoring. The GBM mission is about improving the environment and livelihoods, as a result of tree planting. While it cannot be doubted that the trees planted do somehow contribute to these impacts, there no concepts and systems as yet developed/put in place to monitor that, and it is only recently that this issue has started to be addressed after the recruitment of a Monitoring and Evaluation Officer in April 2009.

Table 6: Forms used in relation to the 10 steps procedure of the Project

Form 4	GBM Registration Form
Form 5	Tree nursery status
Form 6	Tree promotion
Form 8	Digging holes
Form 9	Tree issue for planting
Form 7	1st follow up after 3 month
Form 12	Final follow up at 6 months
Validation form	> Extension officer validates and compensation follows

Source: Green Belt Movement

4.6.2 Forms and their possible improvement

As the objectives of the follow up are also to improve the procedures and the knowledge based upon experience, the forms need to be modified to take the species behaviour into account. For example, until now, only the total number of produced seedlings is counted, only divided into exotic and indigenous species. It is exactly the same for the survival rate after planting and there is no information about the survival rate per species nor about the growth rate per species.

So the forms reporting the number of seedlings in the nursery and reporting the survival rate after planting have to be modified to give the number of seedlings and number of transplants per species.

In addition, a new procedure to statistically follow the planted parcels has to be build up to include the survival rate per species at 6, 12 and 18 months after planting and to include the measurement of the high of the transplants at the control of the survival rate 24 month after planting. All this information is essential for the future of the Project, especially for the bio-carbon sequestration perspective that needs fast growing trees to give a monetary return to the farmers. In fact, the knowledge of the species behaviour in the nursery and on the field should be the basis for drawing an adequate management plan for the tree plantations. It is top priority to have this information which is lacking due to few studies done on these species in the past.

4.6.3. Impacts studies

It would be expected that methodologies will be developed to systematically collect information on variables of impact, such as:

- How and to what extent has the tree planting effort impacted on curbing soil erosion, improving soil fertility, water retention capability of the soil, water quality-cleanliness and safety, and water flow improved; wind breaking effects, air cleaning, returning biodiversity-birds, bees, butterflies, rare species, etc ; for example, sample plots and trees could be identified and followed up for this purpose over time;
- How and to what extent did the trees planted contribute to improving peoples' lives-incomes, reduction of burden, fruits, timber, etc;
- How did the compensation money get invested, how did it get multiplied, and did it improve the livelihoods;
- To what extent has the food security message benefitted the people—how this can be measured ;
- Systematic database of income generating activities-showing incomes generated, how they are used, and impact on standards of living, etc.

All these require a well set out system of measurement, information collection and analysis and reporting, just like there is a system for collecting information on trees planted, verifications and compensations.

There are other goals in GBM vision and mission such as empowerment, winning people to environmental conservation (not only at grassroots but at higher levels). Systematic monitoring of these goals has not been well addressed and concepts need to be developed.

4.6.4. Monitoring and evaluation

Evaluation can be both internal and external. The organization itself needs to conduct self evaluations from time to time to determine the direction of the various Projects it is implementing; these would be scheduled reviews, either biannual or annual, ideally conducted by someone else in the organisation (not the those directly implementing the Project), and giving a full report. Such self evaluations would form a good benchmark for the external mid-term review and end of Project evaluations. These evaluations could be done by the Steering Committee, or even the Local Coordination Units, or the Programs Management Committee, or even by a team drawn from other Project officers, or by the Monitoring and Evaluation Officer. So far, we did not see evidence of self evaluations, happening on a planned a regular basis.

Perhaps the above situation can be attributed to the fact that traditionally, GBM did not have one person/department in charge of the Monitoring and evaluation function. It is only recently (from April 2009) that a Monitoring and Evaluation Officer was engaged. For the last five months or so, she has been trying to study how GBM works, to consolidate on previous experiences and to plan on how the monitoring/evaluation function in the organization can be advanced to a more complete level.

A Project management flow chart has been proposed showing how and when the GBM internal Monitoring and Evaluation team interact with the Project, from the Project idea to the final report and review of the Project.

4.7 External expertise

4.7.1. State of art

Three years after the inception of the Project which is now reaching its final stages, the state of affairs regarding the use of external expertise by the Project is low or came too late when it was produced. For example, the biodiversity study was not done as early as initially expected, and the socio-economic study has not been conducted yet. At the same time, external expertise, outside these studies and the external evaluation, have been less used to assist in technical aspects of the Project implementation – with the exception of a short field visit associating two CIRAD experts who gave some advise on the nursery and plantations issues (AFD / USAID joint supervision mission – November 5 and 6, 2008).
For example, it would have been strategic to use more intensively short term expertise to assist with the issue of IGA. As a result the Project could not take advantage of these major and needed studies/expertise which should have been delivered right at the start-up of the Project.

4.7.2 Environmental baseline study

The study on biodiversity was produced by mid-2009. As expected considerations if not guide lining from this study could not be taken into an account by the Project in its development stage, its impact on biodiversity issues is limited, or for the least could not be

properly explored. This study is essentially informative and is of rather limited interest for the short time. Nevertheless, it is a starting point for further comparative studies that will follow the environmental impacts of the Project and of the other KFS and KWS actions drawn in the gazetted forest and in the National Park.

In addition, the study questions the demand of the Project and how such a study could better serve the objectives of the Project in the short term.

4.7.3 Scheduled socio-economic study

The socio-economic study is to be produced by the end of 2009. Hence, this study, at the time scale of the Project, is of little use and application in its ending stage; but it can be a result of the Project and/or a starting point for a possible extension of the Project. Nevertheless, as indigenous species are mainly slow growing ones, they have no socio-economic impacts yet; so, it seems to us that that study should also focus on the socio-economic impacts of GBM older tree plantations. This information may be very useful for the future management of the trees even if it concerns essentially the trees planted in farmlands.

Nevertheless, that study is essential to understand the uses of the compensation grants and to know how they contribute to the poverty alleviation in the Project area. Such a study should confirm our impression that something needs to be done in order to improve the compensation efficiency for the development of self-improvement initiatives.

4.7.4 Proposals

In the short term (2010), results of the baseline studies, and notably from the biodiversity study, should help to give a proper reflection of water and other natural resources issues, and help the Project in better rationalizing the selection of species, the monitoring and assessment of the plantations.

At the same time, a supplementary study could be envisaged and carried out, anchored on integrated management of natural resources management, bridging together the environmental, social, economic and territorial issues, and notably in the perspective of the new deal between CFA and KFD, the community based management plan of forest (integrating watershed and farmlands)

In the longer term, the results of two baselines studies should not be ignored and should serve renovated approach in possible future activity, in continuation with the current Project.

4.8 Relationship with the Project donor, interaction with other donors

Some donors of GBM are acting in the Aberdare area on same or similar issues: AFD and USAID on Tree and Watershed issues and WB on Trees and Bio Carbon issues. They regularly meet and basic information (reports, etc) is made available and exchanged between these Projects, their managers and donors.

4.8.1 AFD

The Project maintains good relationship with the donor, the French Agency for Development (AFD). Regular meetings are held every three months and minutes are taken. So far six meetings have been held, and three AFD supervision missions and field visits took place in 2007, 2008 and 2009, allowing a good follow up of the Project.
Some of these missions associated one donor acting in the same area (USAID/GBM Watershed Project), and CIRAD, a French research organization involved in various forestry Projects in Kenya.

4.8.2 USAID

USAID is supporting a GBM Project in the Eastern part of the Aberdare, of less financial importance and therefore less coverage but with similar objectives to AFD funded Project. Indeed, its primary objective is to restore the degraded areas in and around water catchments, conserve local biodiversity and improve livelihoods of participating community members (3 constituencies in Nyeri District, 286 tree nursery groups registered, 539 ha planted in public and forest lands, within the Sagana river water catchment).

As AFD and USAID Projects have common objectives, work with the same categories of communities and stakeholders, and are facing the same challenges, they should interact more, notably at methodological and impact evaluation levels.

Interaction could be structured through the reciprocal participation of the donors in the respective steering committees of the Projects they support. And for the less, joint reflections and actions, through meetings and field visits could be envisaged on a more frequent mode (following the joint supervision field mission of November 2009) for the benefits of the Projects and the donors, in terms of coherency and impact.

Finally, results obtained on both sides could be shared and discussed, with the perspective of extending donors support in the near future; through revisited approach (still focussing on key catchments, but probably more landscape management oriented on USAID side).

4.8.3 The World Bank

Acting with GBM, the World Bank does not finance any tree-planting Project; in contrast, the WB has a trust fund that aims to pay for bio-carbon sequestration. There is an agreement between WB and GBM (GBM acting as representative of the grass root organisations) in which it is precisely stated that carbon sequestrated will be paid US$ 4.2 per ton of CO_2 from 2012 through to 2017. That price is very low and below the actual rate. GBM has as objective to sequestrate 375,000 T of CO_2 in 1870 ha of plantations localised for 70% in the Mount Kenya region and for the other 30% in the Aberdare. A limited licence (see below) was signed between GBM and KFS on the land under the responsibility of KFS allowing GBM to plant indigenous trees and to be paid for carbon sequestration. An MoU was signed between GBM and KFS for the partnership in implementing the Project, with GBM acting on behalf of the communities. The community forms association working in this Project areas have

signed community forest management agreements with KFS that gives them exclusive user rights, accessibility to the Project sites and utilization of non- timber forest products. The *modus operandi* to transfer that payment from GBM to the root community associations (CFA) is still to be definite.

Licence for planting, protecting, and conservation of indigenous trees in *Kamai, Ragia and Kipipiri* forests

Subject to the provisions of the Forest Act (Cap. 385) and Rules made there under and to any amendments thereto in force at any time during the currency of this license and to the conditions contained herein **Lari and Kipipiri** Community Association **(**hereinafter called "the licensee") is hereby granted permission to plant, protect and manage jointly with FD 219.69 ha of Forest in **Kamae, Ragia** and **Geta** Forest Station, the area is marked in color edged blue and described on the boundary schedule below.

At the same time, a capacity building PHRD Grant to support the development of carbon finance Projects under the ministry of environment and mineral resource is in place. The grant under the management of MEMR is expected to support GBM BioCarbon Project and strengthen the institution frameworks and DNA operations in MEMR. This grant has already contracted *Unique Forest* consultants as CDM Project landscape specialists who has been working with GBM for the last three years. Even though GBM has submitted the TOR to MEMR for hiring of a GIS specialist to help in monitoring of the Project the same has not been effected. The GBM BioCarbon Project also has a budget line that goes towards stakeholder dialogue and partnership and hiring a landscape forestry specialist which will go toward a social impact study. This is a shared grant between the MEMR and the GBM and the MEMR is expected to benefit by hiring CDM legal specialist and a CDM forestry specialist.

The WB regrets that the expenses are so low, about 10%, of the budget.
For the second phase that starts after 2017, GBM will need to renegotiate the contract with the WB particularly the carbon price.

WB is studying a way to estimate the carbon sequestration (or release) in agricultural soils and a way to pay for that to the small farmers. Payment should probably be done also if the level of carbon in the soil is still maintained. If this idea goes to conclusion, it should be a good opportunity to small farmers to adopt good land and water management practices.

The WB through the BioCarbon Project aims at rehabilitating the forest bio-diversity and improving the water catchments. Although it is not ready to pay for these environmental benefits, WB is encouraging the private sector to pay for environmental services and that may be an opportunity for GBM to get funding for the plantation of indigenous trees that sequestrate less carbon than exotic species.

WB proposes that trees for carbon sequestration be planted in buffer zones, between the gazetted forest and the farmers' crops. If such buffer zones exist in the Project area, it should be possible to use fast growing exotic species that will have a good monetary return in terms

of tons of sequestrated carbon. At the same time, restoration of forest could be done at lower price, by using these buffer zones as protection against browsing and fire.

Carbon sequestration using indigenous species in gazetted forest is an option that may not be neglected. But as use of pioneer fast growing species as Dombeya, Croton or Hagenia spp., is more appropriate than others, they should be planted as a priority - at least by 80%- to get and sell high quantity of sequestrated carbon. The remaining 20% could be composed of tree species providing complementary diversity and added value as Olea, Prunus, Juniperus spp and other timber or medicinal species. Appropriately planted in space, and when mature, these trees will constitute a close canopy forest.

4.9. Relationship with main stakeholders

4.9.1. Relationship with technical Ministries and Services

The Project has strong relations with KFS, KWS, The Ministry of Water and Irrigation that are involved in the steering committee; so advice from these structures can be easily integrated in Project management.

GBM works in cooperation with the KFS the KWS and the Kenya Army, and this set of partnerships was fruitful in implementing the AFD Project. The KFS was involved in providing the communities with advice on tree species selection, providing the planting sites in gazetted forests, providing transport at certain times and will continue to care for the trees beyond the Project period. Even now, they provide the GBM green rangers much needed support. While the cooperation with KFS is strengthened by an MOU allowing GBM to plant in gazetted forests; nevertheless, there may be some difficulties resulting from differences in approach between GBM and KFS especially with the PELIS programme. The KWS provided security in places of its jurisdiction. The Kenya Army provided transport and labour to assist the communities in mass planting some sites. Other players, such the Ministry of Water, Water Resources Management Authority, World Bank have all been part of the consultative process for this Project and have contributed to shape its design and methodology.

The case of the KFS PELIS Scheme

PELIS is the Plantation Establishment and Livelihood Improvement Scheme set by KFS to re-afforest 16,000 hectares in two years under the revamped shamba system – see http://www.kenyaforestservice.org/index.php?option=com_content&task=view&id=13&Itemid=85.

The Programme is intended to forest-adjacent communities and notably the "landless farmers" allowing them to get access to forest areas and grow crops during three years, while planting trees for KFS and taking care of them. At the end of this period, about 90% of the trees planted have to be alive and correctly managed. There after, farmers will move to another plot for new cropping and tree planting. Although the programme contributes to communities' livelihoods, it firstly aims at producing wood, usually through fast growing exotic species, and contributing to country's timber needs.

Under that scheme, which is part of the New Forest Act, farmers in the zoned areas will have to be members of registered and active Community Forest Association (CFA) with powers to vet needy farmers who also have conservation credentials.

The worry of many environmentalists, including GBM, is that PELIS is taking the place of a previous shamba system which, opened forest areas to many abuses, was a failure regarding the planting of trees, and transformed many of these areas in grazing lands or degraded lands

PELIS will operate in the close neighbouring, if not same areas, of the Project sites; and as it will recruit local people as forest workers, on such sites, one may ask the effect of this scheme on the mobilization of communities acting for the Project. Actually, such workers are paid KShs 220 per day for pruning, thinning, harvesting, etc of KFS plantations. This may induce some difficulties for the Project considering the level of the compensation paid – beyond the fact that this is just a token- and the delay for its payment (8-9 months after tree planting) when PELIS farmers will get a quick return from their crops and work provided the KFS (out of planting and taking care of trees which are part of the contract).

4.9.2. Relationship with Research

Current relationship between the Project and research organizations or Projects acting in the same domain of interest (environment, sustainable management of natural resources, forestry and agroforestry, land and water management, etc.) are poor and insufficiently explored. Scientific background and basic data produced by these institutions and Projects – or are available in specialized libraries in Kenya or on the net - are little used by the Project or not regularly done.

Among them, KEFRI is to be more associated and visited considering their various results on indigenous species (ecology, behaviour, silviculture, etc.) including old but useful data that could certainly be more exploited. Germplasm from Tree seed centre of KEFRI is currently not utilized by field staff as seeds are too costly for TNG and, according to them, germination of most species they purchased and tested was poor. Such an issue should be reported to KEFRI and discussed by the Project officers with the perspective of controlling seed viability and treatments to improve the results.

ICRAF library and services could be much more utilized. It is noted that the tool kit that GBM uses for training EO on silviculture extension is borrowed from ICRAF. R4D teams and services of ICRAF should be regularly met or exploited - such as the *Agroforestree Database* and the *Tree seed suppliers* directories (accessible on the net).

Other R4D organizations, such as CIRAD and IRD, located on the ICRAF campus, have to be met as well considering the large experience they have in management on natural resources (water, soil, forests, biodiversity) and particularly in Kenya and its sub-region (see : http://www.cirad.fr/en and http://www.ird.fr).

On the university side, GBM is currently setting up an Institute, in partnership with the University of Nairobi. This institute, through appropriate curricula for graduates, will address issues of sustainable management of natural resources, and therefore will offer an excellent opportunity to provide students and officers with strong scientific background, and such issues, and properly trained them as development officers.

4.10 Training and capacity building

The GBM training and capacity building given to extension officers (EO) and the tree nursery groups is important, and organized at Lang'ata training centre, Nairobi; it is the duty of the EO to extend training to the groups on the field.

4.10.1 Training of extension officers

GBM extension officers are charged with the responsibility of training the communities. At the time of employment, the extension officers already do have a good foundation for their work. Most of the extension officers are employed with a diploma in forestry. After employment, they go through substantial training in GBM, first a two week intensive session in Lang'ata, and then various short term (one to three days) sessions on re-call from the field. All in all, the following topics are covered as follows:

Technical guidelines in seed production

Seed sourcing; Seed collection; Seed processing; Seed storage; Seed dormancy and pre-sowing treatments; Seed quality, physiology and genetics; Seed distribution; Seed documentation; The private sector and seed production; The business approach; Marketing seeds and seedlings; Tree nurseries as enterprise; Tree seedling quality;

Tree nursery establishment and management

Nursery preparation and maintenance; seedling handling; planting; maintenance and protection in the site

Strategies for scaling up seed production

Seed production and distribution strategies; Field research; Extension; Training; Information sources; Species selection

Food security (and ecological intensification of farming systems)

Concepts of food security; traditional foods; organic farming; agro forestry; multiple cropping techniques; water harvesting; soil and water conservation.

Civic education and Advocacy

GBM history, structure, mission, vision, values, programs and methodology; Mobilization of communities; advocacy and extension; fighting for our rights; conflict resolution; networking with other stakeholders.

Project management
Proposal writing; budgeting; Project implantation; monitoring and evaluation; report writing; GIS.

The Extension Officers are required to extend to the TNG the same training they receive at Lang'ata Training Centre. This they do by addressing each group as it forms. Through this process, the groups seem to have been given, very successfully, training on organization, the values of GBM, nursery establishment and management, through the ten steps system. Some training on food security and water harvesting has also been provided.

The first intensive trainings are done on a modular basis over the period of six months until the TNG has started to plant trees.
Most of this training is conducted over a three week intensive period when the EO join the organization, and it is then enriched by regular short visits back to the Lang'ata Training Centre for further inputs.

4.10.2 Training of the tree nursery groups (TNG).

The trainings are delivered to tree nursery groups (TNG) on a modular basis, with the extension officer, and green rangers, visiting each group at least once a month for purposes of monitoring and training, until the group is well matured. At that point, the group can be used as a focal point for training other new groups in the network, or other nearby networks, with its site being used as a demonstration, and even some of its members playing the role of resource people.

Thereafter, more training is done, depending on how the extension officers assess the need of the group, or depending on their demand. For example, if a group would want to start a beekeeping Project, the extension officer will arrange on how this training may be provided, sometimes using resource people from some of the other institutions.

Between 2006 and 2007, the following training/mobilization events were organized:

Table 7: Training on formation of TNG and networks

Constituency	**Date**	**People trained**
Kigumo	24-25 Oct 2006	96
Lari	26-27 Oct 2006	95
Gatanga	15-16 May 2007	96
Gatanga	17-18 May 2007	97
South Kinangop	23-24 May 2007	96
Limuru	13-14 June 2007	95
Githunguri	28 Feb-2 March 2007	105
South Kinangop	11-13 April 2007	106
Limuru	28-30 March 2007	100
Total		**886**

Table 8 Training on formation of Community Forest Associations (CFA)

Constituency	Date	People Trained
Gatanga A	15-16 May 2007	95
Gatanga B	17-18 May 2007	97
South Kinangop	23-24 May 2007	96
Limuru	13-14 June 2007	96
Total		**384**

In total an important number of people were trained: almost 900 members from groups and networks, and 400 from CFA.

But while the training for the extension officers and group members is quite well done, there is a weakness. Except for the Civic Education manual, the other training has not been put into trainer manuals form. Trainer's manuals help to enable consistent, more uniform delivery of training, and also to give a platform for regular revisions depending on emerging needs and scenarios. Also the material delivered to the TNG is either in form of notes the EO got from Lang'ata, or they do their own notes. There is nothing that is given to the TNG such as some aid memoir kind of pamphlet.

4.10.3. Proposals

It is imperative for GBM to have the training materials put in form of manuals like the civic education one.

It would also be important to put the TNG trainings into do-it-yourself pamphlets, which can be distributed to the group members. These pamphlets would be widely read by other people, who are not group members also, and their children, and this way more people can be reached by the GBM message on environmental conservation and best practices for tree planting.

It appears that the trainings given to extension officers are essentially practical although they have already a forestry diploma. It should be advantageous for them to get more information/ re-training on strategically land and forest management to be able to advise on global land management (necessary to water catchments management) and on forest management (to have a prospective overview of the planted area and management).

4.10.4. Technical and support tools

Manual and rules of Procedures

The Implementation Manual and Rules of Procedures of the Project have been recently revised (12/02/ 2009). So GBM has a guide at one's disposal for the disbursements of Project's funds by AFD, management of the renewable advance, procurement methods, anti

extraordinary commercial costs (ECC), communities' compensation procedure, reporting and AFD prior no-objection.

In that package, the communities' compensation procedures should be (maybe there are) the same for all the GBM Projects. As we further are proposing a reflection one these compensation procedures, these ones will probably evolve in the future.

Computer system and softwares

GBM made recently the acquisition of a very well performing computer system. This will serve for one part for the analytical accountancy of all the GBM Projects (this will be fully operational next December), and for the second part for the Geographical Information System. The latter is already operational but not totally. It seems that the links between the geographical coordinates of the nurseries or planting sites and the work done and the accountancy is still being built.
Once these 2 tools fully operational, in a few months, GBM will have excellent tools for monitoring and evaluation of their Projects but also for manage them.

GBM has to develop a scientific follow up of the Projects, with the help of external consultants associated with PhD students and research centres and universities. This follow up does not only concern the environmental impact of the Projects, but also the economical and social impacts in term of livelihood and cultural development. This is a big challenge for GBM because such an impact study may not be stopped at the end of each Project but has to be conducted for a long time, as environmental and mentality changes take a long period of time.

Documentation - Library

Although most of the information are available through the Net, a technical and scientific library is necessary because there is too much information on the Net and because these may be not relevant. These documents may also be of help for training and extension pedagogical books that GBM will have to produce soon for tree nursery groups, for children at school (a new programme that is into preparation).

Communication:

GBM internal communication

Internal communication: during our mission we had the feeling that there is sometimes not enough information exchange between GBM members. Although they show willingness it was sometimes difficult to get the relevant information. As all the Projects have the same global objectives, we recommend initiating inter-Projects meetings to promote the exchange of experiences, to find joint solutions and to reinforce the GBM spirit. Some professionals from KFS, KEFRI, KWS, etc. may be invited to give professional advice and to help to find specific solutions.

GBM external communication

External communication is essential to internationally promote GBM actions and to help in fundraising.

In the Green Belt Movement Internet site there is a lot of information on Prof.Wangari Maathai and her ideas. It is very interesting to read about these concepts. On the contrary, there is more or less nothing about the AFD/GBM Project or about older Projects or new other Projects conducted by GBM.

Nevertheless when you are in the field you may see the impacts of the GBM Tree Planting Program (Phase 1): Tree planting on private land (farms, schools, churches, etc). Even on Google Earth the results of the awareness of tree planting is visible.

So impressive results have to be presented everywhere in the world and especially in Africa as example of what to do. It is urgent for GBM to add some pages to their site with data on trees planted, on trees growth, on people resources increase due to wood production and other annex GBM programmes. All these data shall describe the current mutation in the farmlands livelihood.
Such data is the basis on which it will be possible to build up new Projects and to obtain the related funding.
So, the GBM Internet site has to be improved by adding new pages presenting all the current Projects. These new pages would present the objectives of the Projects, map location, work done or being done, results in tree plantations and also in other important changes as small stakeholders' implication, poverty alleviation, etc.

At the same time, as the GBM grassroots members don't have access to Internet, it seems necessary to produce a newsletter to inform them of how GBM is acting and what progress has been made. Some interviews of farmers showing their motivations, how they are acting or how they earn more money by selling wood or through new activities initiated by GBM such as beekeeping, etc.

5 Finance and accounting

5.1. Finance and Accounting

GBM operates a program driven finance management system where transactions are processed based on the following criteria

- Grant (donor)
- Thematic areas (Tree planting, advocacy, civic & environmental education, program management etc)
- Budget lines – as agreed with the donor when the finance agreement was signed
- Restriction status – whether funds are restricted

The GIS system has developed a geo spatial data system where activities on the ground are mapped to ensure that they are traceable and exist.
The current process synchronizes the GIS data base with finance database to ensure that transactions are processed for activities that have been mapped. It is envisaged that this system will further enhance accuracy and timeliness of reporting.
The finance system is all inclusive and generates reports on funds received from the donors, what has been spent for the reporting period and overall period since the donor engagement came in to place.This GIS system is very good but is yet to be developed and updated. At mid year, only 24% of the 2009 budget had been spent on items such as:

- Meetings, workshops and trainings for staff and stakeholders and production of materials related to this.
- Communication tools(website), lobbying abd dissemination
- Studies and external education.

For the budget, see **Figure 2**.

5.2. The Compensation system

According to the Ten Steps procedure, the compensation can only start to be processed 6 months after the groups planted the trees. From there, it takes at least three months on average for survival verification and processing of payment. For the groups it this is too long a time to wait.

On the amount of the compensation, most of the groups we interviewed felt that the KShs 5 compensation is too small, although they agree with the principle of voluntarism, perfectly understand the meaning of token, and that their contribution is essential. And for some of them, too small a token of appreciation can lose its significance.
Another point is that the survival by six months is usually affected so much by other external factors, such as grazing by pastoralists, destruction by animals, etc, factors outside the direct control or responsibility of the community.
It has been proposed that the token will be increased to KShs 11, payable over a two year period, but still with the first amount of money coming after 6 months and based on survival count.

Figure 2: Budget figures for 2009 and expenses at mid term year for the GBM/AFD Project

BUDGET DETAILS	Expenditure Jan - Jun 2009 Budget	2009 Full Year Budget	% Usage of funds
Mobilization workshops and capacity building of members	406,400	1,240,000	33
Advocacy workshops to rally community supports for forest protection		989,500	0
Networking workshops	92,232	1,200,000	8
Technical training for staff members, Green Volunteers, groups members	68,197	1,764,000	4
Meetings, public hearings and contribution to develop overall forest management plan		516,000	0
Plantation zones analysis and tree planting and nurseries planning	29,125	500,000	6
Planting procedure document for networks members		480,000	0
Tree planting survival follow up records	383,398	1,553,000	25
Provision of planting materials and tools	126,000	150,000	84
Indigenous and exotic seeds procurement		400,000	0
Collecting seeds, setting tree nurseries, planting and nurturing and protecting trees			0
Transport of packed tree seedlings	142,886	633,000	23
Conduct tree planting days for the community members	312,950	590,000	53
Nurturing and protecting planted trees (procurement)	145,050	2,160,000	7
Seedling payments to communities	2,304,966	6,500,000	35
Studies and policies repackage for advocacy	600,558	2,000,000	30
Local networking and mobilization of institutions and leaders	262,475	300,000	87
Mass education	-	300,000	0
Video documentation of Project events	13,000	180,000	7
The 10-steps procedure for public lands and lessons learned from the Project		220,000	0
Web site + synthesis document		450,000	0
National GBM-Forest department workshops and exchange visits		800,000	0
National lobbying on forest policy		240,000	0
Dissemination of the documents		200,000	0
Overall coordination and general charges (see breakdown coordination)	2,223,313	5,491,264	40
Vehicles (2 new 4x4 pick up double cabin or 4 second-hand)			0
Technical assistance	2,754,000	7,008,000	39
Internal technical and financial reports	-	84,000	0
Financial audits	-	700,000	0
External Project evaluations	-	3,480,000	0
Contingencies		1,000,000	
Total	9,864,550	4,112,874	240

Compensation grants should be used to induce or motivate groups and their members to invest in other activities that will give them more opportunities to earn money and alleviate poverty. The earlier they could get their compensation the prompter they will be able to invest for their future.

Consequently, it would be appropriate to modify the calendar of the payment –and have part of the compensation paid as soon as possible – that is to say one month after planting. – keeping in mind that in the first phase of the Project, planting trees in farmlands, schools and churches, the KShs 5 were paid soon after planting.

The amount of that first payment has to be studied but this payment should be independent of the survival rate because taking into account all the work in the preparation of the nursery and planting. After the first payment, the successive instalments should remain the same, i.e. 6 – 12 – 18 and 24 months, depending on the survival rate.

On the other hand, one has to consider that the amount of the compensation did not much evolve with time, apart from the only one shilling added to compensate the farmers for the potting bags purchase. For the last 10 years cost of living in Kenya has highly increased, and many poor farmers are now becoming extremely poor. So this is an additional reason for re-evaluating the global compensation within reasonable limits without changing its status as a token or affecting voluntarism.

Accordingly, it is proposed that the KShs 5 should be paid in two instalments: the first payment of KShs 3 immediately after the trees are planted; and the second one of KShs 2 to be paid for survival counting. Then after the system can now continue as proposed for the rest of the two-year period.

PART 3: ACHIEVEMENTS AND FIELD RESULTS

6. Outputs and deliverables per component

The Project success can be reviewed against what it has been designed to achieve, right from the onset. As given in the logical framework of the Project, scheduled activity is to be implemented in two methodological and technical components (1 and 2), in addition to management and contingencies components (3 and 4), and expected outputs have to be assessed according to performance indicators, and corresponding measurable deliverables (**see Appendix 8).**
These deliverables constitute the quantitative part of the results, but many aspects of qualitative nature, are not mentioned in the log-frame of the Project. As they cannot be ignored, they have been analyzed and reviewed here and under each component.

The methodological and technical components and their expected outputs are interrelated, one supporting the other, and their achievements are therefore reviewed in that manner.

In our opinion, in spite of some difficulties or delays in the achievement of certain outputs and deliverables, most of them have been vigorously pursued, and global achievement can be noted on quite a commendable scale.

6. 1. Rehabilitation of the degraded areas of the Aberdare forest ecosystem in the public lands (component 1)

This component comprises the following outputs**:**
- Forest ecosystems rehabilitated (the main and global objective of the Project);
- Relevant skills introduced in communities for tree planting and protection (training, etc)
- New livelihoods promoted for the sustainable use of the forest ecosystem, especially for women (considering the gender basis of the GBM groups)

As trees are at the very heart of the Project, the review, under this component, had to go beyond the sole number of trees planted and their survival: knowledge on indigenous species, criteria of selection, nurseries techniques and plantation design and mode are inherent in parts of the forest ecosystem rehabilitation and relevant skills introduced in communities for tree planting.

6.1.1 Forest ecosystems rehabilitated

6.1.1.1. Voluntarism as the basis to Forest ecosystem rehabilitation, contributions in time and money of the groups

Forest ecosystem community based rehabilitation cannot be a single matter of techniques and money.
Due to the high level of well executed consciousness raising and mobilization, there is remarkable community participation based on voluntarism, which is the main rallying point

for most of the effort we witnessed. Some of the substantial contributions from the community are:
- *Providing plots for the tree nurseries*. Three of the 12 nurseries we visited were on plots donated by individual members (and poor farmers) of the groups. Other nurseries were on public sites provided by the authorities, such the KFS, the chief, etc.;
- *Contributing money to buy potting bags, manure, spray chemicals, seeds and other inputs*. All groups indicated that to start with, they contributed their own money to start the nurseries, and they still do so regularly to keep the nurseries going. Thereafter, they spend about 1/3 or more of the compensation they get to invest back into expanding the nurseries. GBM does assist with the bags but these have not always met the groups' needs;
- *Time spent in nursery work*- collecting seeds/wildlings, seed germination, transfer to potting bags, watering, security, weeding, and other care;
- *Provision of tools and equipments for working in the tree nurseries*. All the nurseries we visited at present were worked on using tools provided by the members;
- *Time spent for planting the seedlings*. The groups join hands as networks to plant the seedlings in the forest sites;
- *Time for after planting care: watering and weeding*. Some of the weeding care is provided by the green rangers, who are paid, but most of it by the group members.

In total, the number of days spent by the groups for the nurseries and tree plantations is high and constitute a considerable contribution in kind, work and money. For example we did a quick calculation with Tiekunu Network and we found out that in one year, the groups had spent 66 days working on the planted site. With the government daily rate of KSh 250 per day for casual labour, this would translate to KSh 2,145,000 (66 days x 130 people x KSh 250). It is important to compare this with the KSh 118,000 token compensation they had received from GBM. In fact, by the end of 2008, with respect to the time the members allow to carry out GBM work without charging for it, it was estimated that each community member had contributed an estimated 40 days. At the average rate of KSh 200 per member per day (average daily wage by then), and with a total of 8,400 members, this amounted to KSh 67,200,000 (Euros 772,414). Compared to the feasibility study amount of Euros 689,655, the community had surpassed their contribution target by 12%, and this was only a conservative figure that did not take all the other inputs that the community had put in, like using their own money, their own equipment/implements, giving out their own plots, etc.

6.1.1.2. Methodological framework: the 10 steps and 12 forms system

The formal procedure used by GBM for seedling production and tree planting, from sensitization on tree benefits to the follow-up operations through the "10 steps and 12 forms" system (see **Appendix 6**) shows a well structured methodology, providing clear guidelines for Tree Nursery Groups (TNG) and allied field staff. Such a step by step system is notably expected to deliver in time basic data on successive field operations and corresponding reporting, according to dedicated tasks and responsibilities. This is logically done in continuation with the group formation and continuous interaction between members and offers a solid basis for group mobilization and commitment. The way of communicating field data to GBM HQ and displaying them (technical reports and figures on compensation) is transparent. But the system in its application appears slow or constrained by various reasons, notably the logistic as detailed in the paragraph ("Accuracy and constraints in collecting data on plantations"). But the data checking system recently established by the Monitoring and Evaluation Cell should improve data accuracy in the near future. In addition to that welcome

improvement, one could suggest that some refresher courses regarding the methodology, its applications and results, on an annual basis be integrated within the system providing the concerned teams with more interaction, through sharing of experiences and concerns, and feedback with the Project management.

6.1.1.3. Knowledge on indigenous species and accounting per species

As GBM is now promoting and planting indigenous species – of totally different nature and destination than species previously promoted by GBM (such as *Grevillea robusta,* an exotic species easy to raise and manage)- there is a need to better know about these species. This includes their reproductive biology, their ecology (behaviour and growth under site specific conditions, notably in forest ecosystem) and moreover their silviculture – viz. from seed harvesting and handling to tree planting and plantation management in pure stands or in combination with crops (agroforestry systems).
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Unfortunately, there is currently no detailed or comprehensive information, with a minimum of scientific background, on the various species planted in different sites and environments of the Project; and there are no figures regarding the numbers of trees planted in time and space per species. Indeed, accounting of trees at nurseries and planting sites levels are globally done according to 3 broad categories: indigenous, exotic and fruit trees species. Forest sites are (almost) exclusively planted with indigenous species, whereas exotic and fruit tree species are planted, along with indigenous species, on public lands –and the same on farmlands (seedlings left after planting time or produced by the groups, for their own use or for sale, not accounted by the Project).

Interestingly, some TNG took the initiative of making detailed accounts of the seedlings they produced by species and season in their own nurseries, answering spontaneously on the need to account as precisely as possible their production of tree seedlings.

Without such an accuracy, both on qualitative and quantitative information, it is not possible to fully assess specific behaviour and performance of planted seedlings and compare this from one site to another one, and therefore to ensure the best monitoring of such plantations in their full floristic and heterogeneous diversity – the mixture of species being a complex and difficult issue to deal with.

6.1.1.4. Species planted in forest sites, types and criteria of selection

A total of 23 indigenous tree species were initially chosen by the Project, in consultation with experts from KEFRI and KFS. They are all native to the Aberdare ecoregion. Additional species, for plantation in public lands and farmlands - notably exotic species of great economic importance to the communities where also considered.

In fact, the number of indigenous species which have been planted by the Project since 2006 in different sites is high, as it reaches more than 40; with 10 to 12 dominant species **(see Appendix 12).** Because many of them are little known and are introduced in various conditions of soil and climate, and also land pressure, one may consider their plantation somehow experimental.

On forest sites, which constitute the main focus of the Project, the planted species can be identified according to two main types of trees and categories of services they are expected to provide in the course of their development, through mixing up them:

- the pioneer, usually gregarious, and/or fast colonizing and growing species such as: *Croton megalocarpus, Croton macrostachyus, Polyscias fulva, Polyscias kikuyuensis,*, *Podocarpus falcatus,* and locally *Hagenia abyssinica,* at highest altitude, and *Acacia xanthophloea* on the driest sites; these species may nurse the slow growing ones in an appropriate combinations and succession*;* planting such species in mixtures is expected to have a similar impact than forest, through the floristic composition and structure that they mimic

- the medium to slow and very slow growing species, multipurpose for most of them, such as : *Dombeya rotundifolia, Juniperus procera, Olea Africana, Prunus africana, Syzygium guineense.* Most of these species are valuable timber species, but this is of little interest to the Project; others may provide various secondary products and services (medicine, beekeeping…). But their main roles are to rehabilitate the biodiversity (through their own diversity and dispersal of germplasm by the frugivorous animals and pollinators they may attract, and their soil and water conservation effect (at least collectively through plantations, serving the watershed objectives of the Project, in addition to possible other environmental services, such as carbon sequestration).

These tree "ideotypes" and corresponding benefits or services are well acknowledged by the extension officers and they constitute the basic arguments for planting such species on forest sites.
But if these criteria and considerations are globally correct, some reservations are to be taken into account:

- because of the high climatic and environmental (soil, water) variability of the Project area, planting trees with species indigenous to the Aberdare or similar Kenya environments may appear not sufficiently discriminating from one site to another one. Criteria for selecting species have to be site specific, hence well documented and thoroughly considered;
- due to the fact that one have little knowledge on many planted indigenous species, their behaviour and performance, individually, and moreover in combination with other species, it is difficult to figure the development of mixed plantations in 5 to 10 years when trees planted at 3 to 4 m spacing will start competing. Hence, one may question the rationale in combining different species -up to 12 to 15 species on 30 to 50 ha in a totally randomized way- and the future of such plantations, at risk (competitive effects, survival, which management, etc).

Otherwise, at TNG and nursery level, it is important to note that species selection results from different and concrete reasons, linked to limited capacities of the groups:

- *seed availability and cost*: as TNG can hardly afford high cost of seeds (from KEFRI or private companies) or because of poor access to commercialized seeds, they prefer to collect seeds (and sometimes wildings) in the forests. But for some species, it is difficult to collect seeds in forests because of low or no fructification in certain years, damages on seeds by insects and wildlife, or simply rareness of species vanishing due to their overexploitation. As a matter of fact, certain endangered and valuable

indigenous species the Project should focus on and promote locally are not in the priority list of species planted by the TNG ;

- *knowledge on germplasm, seed treatment* : low germination rate of certain certified forest seeds that TNG purchased is given as an additional argument; this may be partly due to inappropriate conditions of storage and insufficient knowledge on seed handling and treatment. Most of TNG and nurseries attendants that the mission questioned seem to have basic knowledge for selecting high quality germplasm on the best trees, but this information which they usually got through GBM training or from forest officers is too much general and not relevant for certain indigenous species, little known or previously tested.

Yet, in the absence of fully rationalized selection of species, with prioritization done on scientific basis, and access to large diversity of quality (selected) germplasm, the trend is to produce seedlings with seeds available, or an easy access and that germinate easily: as such, the practice is efficient to produce large quantities of seedlings from certain species, but it may affect the quality - and tree performance, later on. Finally, such a practice appears locally as a limitation to species diversity (rehabilitation) and adaptability to the specific conditions of certain sites (best suited species to the site, including rare or endangered species, or re introducing species that vanished decades ago).

6.1.1.5. Proposed basic information and methodology for species selection and site characterization to be matched with

To bring some replies on minimizing the risk in species selection and plantation, it is suggested to:

- carry out and report preliminary studies with specifications on sites and candidate species leading to their selection, and design tree plantation combination(s), with map sketches, in accordance with site specific conditions (“best bet”), before any campaign of tree planting (and production of seedlings), for any new forest site. On already planted sites, similar considerations should be made when replacing dead seedlings; mapping these “old” plantations and making use of the results of the field trails they constitute be a very useful source of information for their future management and establishment of new ones ;
- make simple observations (such as sanitary status of trees) and measurements (notably height, and diameter in the near future) on existing plantations to be able to fully assess tree performance and adjust criteria for species selection ;
- simplify the combinations and rationalize them in terms of species (types and numbers) and spatial arrangement – e.g. line by line, or regularly staggered

- rationalize choice of tree species in terms of soil and water conservation impact and other anticipated environmental benefits–without omitting shrubs which may have certain advantages (better cover effect) and take an appropriate space in the multi-layer structure and composite like forest plantations;
- invest and capitalize more on these indigenous species issues and preliminary results – which is a matter of in depth studies. In this perspective, existing links with research institutions (KEFRI, ICRAF, and University) should be strengthened, taking advantage of their methods and experience, and partnering them (studies) in the analysis of field data and dissemination of the results.

- unknown or very little known indigenous species should be cautiously selected and tested on small plots before extending their plantation on larger areas.
- for all these aspects, recruit or make a larger use of external expertise

As it is essential for the Project to improve its knowledge on candidate tree species and their plantation and management under different site specific conditions of the Project area (climate, soil, water, and other data very much missing), it is suggested to set up a small unit (or to constitute a team, with the Head of the Project) aiming at :

- collecting, analysing and making large use of scientific and technical information and data, from the literature, on germplasm traits, seed harvesting and handling, and behaviour of indigenous species. In this perspective, the easiest way to access and review such literature is to browse on the net where various data banks (ICRAF, PROTA, DANIDA ...), grey literature (reports, technical notes, Project experiences, etc) and scientific publications can be found and downloaded;
- organizing the collection of (original) field data on tree behaviour and growth, and allied information (site observations and characteristics, such as climatic data which are not found in the Project studies and reports) from the many plantations developed by the Project. For example, simple comparative analysis of performance (survival, sanitary development and height growth) of a given species on various sites is needed for extending the Project to other sites. And this is basic to better understand limiting factors in growing indigenous species prioritize and finally to promote indigenous species (making good use of field experience) and finally reduce the risk. Thus, the same Project team should be able to collect, enter and analyse such field data and computerize it as an integrated part of the current GIS data base;
- taking into an account traditional ecological knowledge (TEK) that farmers have on indigenous trees, notably when scientific information is cryptic. This TEK could usefully complete scientific information. In this view, TEK surveys should be initiated by the Project, carried out by the extension officers and green rangers and field data collected be computerized as well at GBM Nairobi.

6.1.1.6. The case of species planted on public sites

Public sites include schools, dispensaries, road and parking sites, market places, and other public places The plantation of trees on such sites is done with very different species : indigenous, exotic and fruit species.They may serve various objectives: education, beautification, shade, etc, rather than for production (essentially fruits, and mainly in schools). Species are also planted in mixture, which is relevant for aesthetic as well as for demonstration (education, awareness) reasons.The soil and water conservation impact of such species and plantations (trees scattered or aligned in small numbers) is marginal, with the exception of few crop plots set up in secondary schools where trees are planted in agroforestry systems.

6.1.1.7. Seedlings produced by the Project

The **Tables 9, 10 and 11** present the seedlings produced in the nurseries from 2007 to June 2009. The "seedlings not ready" are those insufficiently developed at the time of the record and that will be planted at the next planting campaign (usually grown during the short rainy season to be planted at the onset of the long rainy season.
Figures on seedling production are obviously not sufficient to asses the success of tree planting and the development of plantations. Number of seedlings raised in nurseries have to be counted by species and compared with corresponding planted seedlings, and on each site, in terms of survival rate and sanitary conditions at successive intervals of time after tree planting (at 6, 12 ,18 and 24 months); this will allow to accurately justify the compensations to be paid to the farmers and insure, in space and time, the needed follow-up of the plantations.

Table 9: Seedlings ready[a] and not ready[b] in the tree nurseries in 2007

Constituency	Networks	Tree Nurseries	Seedlings Ready	Seedlings not Ready
Gatanga	10	60	203,625	209,778
Gatundu North	10	34	215,238	180,037
Gatundu South	15	74	109,478	189,442
Githunguri	2	9	26,908	9,845
Kangema	6	52	28,357	116,077
Kigumo	7	40	83,650	82,220
Kiharu	7	46	51,162	52,702
Kipipiri	6	48	119,075	246,815
Lari	14	65	205,010	324,514
Limuru	9	40	84,470	154,610
Mathioya	8	46	112,486	116,907
North Kinangop	7	22	209,840	203,200
South Kinangop	4	28	19,160	73,334
Total	**105**	**564**	**1,468,459**	**1,959,481**
Grand total seedlings				**3,427,940**

[a] *Ready to be transplanted to planting sites*
[b] *Young seedlings not ready for transplanting*

Table 10: Seedlings ready[a] and not ready[b] in the tree nurseries as at June 2008

Constituency	Networks	Tree Nurseries	Seedlings Ready	Seedlings not Ready
Gatanga	10	45	87,929	81,749
Gatundu North	6	28	97,952	146,700
Gatundu South	12	45	103,771	92,293
Githunguri	3	12	29,103	12,038
Kangema	6	44	9,787	77,272
Kigumo	6	30	58,520	56,360
Kiharu	9	82	16,367	128,014
Kipipiri	6	56	232,011	223,975
Lari	14	66	173,953	184,189
Limuru	6	22	45,640	18,150
Mathioya	8	46	112,486	116,907
North Kinangop	7	22	209,840	203,200
South Kinangop	4	28	19,160	73,334
Total	**97**	**526**	**1,196,519**	**1,384,181**
Grand total seedlings				**2,580,700**

[a] *Ready to be transplanted to planting sites*
[b] *Young seedlings not ready for transplanting*

Table 11: **Seedlings ready[a] and not ready[b] in the tree nurseries as at June 2009**

Constituency	Networks	Tree Nurseries	Seedlings Ready	Seedlings not Ready
Gatanga	9	35	25,144	79,473
Gatundu North	7	36	134,162	121,195
Gatundu South	12	47	14,800	220,431
Githunguri	3	13	28,923	12,734
Kangema	6	43	4,800	91,773
Kigumo	7	32	25,840	82,827
Kiharu	9	79		156,011
Kipipiri	6	54	110,193	180,079
Lari	15	72	197,827	168,565
Limuru	6	26	29,570	21,000
Mathioya	11	23	800	29,630
North Kinangop	7	30	27,840	29,600
South Kinangop	6	26	16,940	12,230
Total	**104**	**516**	**616,839**	**1,205,548**
Grand total seedlings				**1,822,387**

[a] *Ready to be transplanted to planting sites*
[b] *Young seedlings not ready for transplanting*

6.1.1.8. GBM assistance to the groups and their nurseries

The assistance with potting bags is quite substantial, although very much variable from one year to another one. For example, it reached 2.57 million bags in 2006 and 5.1 million bags in 2007. This was commendable assistance, though it was not always to meet the needs of all the nurseries, which were being registered all the time. There were no bags bought in 2008, as it was expected that the groups would be recycling those bought in 2006/7. So far, in 2009, about 0.5 million bags have been issued.

Further to this GBM did assist the groups with fuelling KFS vehicles to transport seedlings and people to planting sites, also with carrying soil for some of the nurseries that were in dire need for it.

6.1.1.9. Technical knowledge, information sharing at nursery level

Technical knowledge and local experience of TNG in the management of their nurseries (constraints, improved practices, etc.) are unequally shared between the groups. More interaction, if regularly organized within networks that the TNG constitute and between neighbouring networks sharing the same agro-ecological zone, could certainly help in upgrading and homogenizing the practices (for example, on germplasm collection and treatment, germination tests, raising seedlings of little known species).

Nursery techniques have been known and popularized for a long time in Kenya and there are many technical guidebooks, booklets and notes on the subject that could be systematically distributed to the TNG (see some titles in English and in Swahili in the list of documents consulted, **Appendix 4).** Most of the nurseries the mission visited during its field trip have a good technical level, but as some of them do not totally master certain techniques (or forgot their principles years after the training they received) a few basic points are reminded here below.

Seed collection and storage

Correct (sub-) species identification; location of the mother tree according to well mastered criteria (this tree should be designated by a number and a painted mark); harvesting date, harvest on the tree or on the soil, with accurate sanitary appreciation; seeds drying: in the sun, in the shade…; storage: in the cold, at room temperature,…; seeds pre-treatment: scarification, acid, hot water, etc.

Sowing and germination rate

Mention of species, sowing date; number of seeds sown or weight of seeds if the seeds are very little ones; number of days until germination begins; number of seedlings week after week until germination is completed; size of the seedlings at transplanting time, etc., without omitting regular reporting in appropriate nursery book.

Raising up of seedlings

Mention of species, transplanting date; number of seedlings transplanted into the potting bags; survival rate after 15 days and each 15 days (as the potting bags have to be moved every 15 days to avoid that the rooting system develop itself out of the bag, it is easy to remove the empty bags and to count the living seedlings); seedlings height measurement of a sample every month until planting.

All this technical and scientific knowledge on nurseries and species raised (frequently newly introduced) is necessary to correctly manage the nursery schedule from seed harvesting to seedlings plantation. Until now, most of this knowledge is lacking – or for the least it is insufficiently gathered, applied and reported –and validated as best nursery practices for most of if not all the tree species.

As it is time consuming to collect such an information, or what exists on the subject, and very difficult for the TNG to access to it, it is appropriate for the Project (officers) to do it in working closely with KEFRI, ICRAF and the University: share their experience (Projects and programmes), access to their data bases and specialized documentation, and possibly recruit students to document the subject and carry out research on scholar practical assignments (diploma in forestry, MSc, etc).

6.1.1.10. Plantation, mode and tree species combinations

On forest sites, plantations constitute blocks of which the area frequently varies around few tens of ha, depending on the forest land area KFS is providing to the Project, seasonally.

Preparation of planting sites, tree planting and care

Plantations are made by members of the nursery groups and their networks and supervised by the Green Rangers. Attendance of members, usually strong at the beginning of the planting season, diminishes with successive operations – as labour force is required in the same time to initiate the cropping season. This unequal contribution of members to plantation work is taken into an account by the group (chairman and its treasurer) at the time of the compensation payment.

Holes are made before the onset of the rainy season along lines (possibly on contour, on steep slopes) and through measurements – without pegging. Spacing is usually done at 3m x to 3 m, on the lines and between the lines; it is not always very much regular and can be locally closer (hence totalling more trees than the 1111 individuals/ha at 3 m x. 3m).

Transportation of seedlings from the nurseries to the planting site is often constrained by the lack of money to fuel lorries that will bring them to the sites in time, beyond the difficulty to access the sites through bad roads and tracks; KFS and the Kenyan Army are regularly providing their services for transportation (work force in addition to lorries from the Army).

Holes of about one foot deep are usually made. Just after the planting of a seedling, soil is (lightly) trampled, and holes which appear sometimes widened by one to two feet may locally act as micro basin for water retention.

Weeding is made two to three times during the rainy season ; and watering is frequently done during the dry season (on to two times per month) –which were very severe in most of the planting sites of the Project these last two years

Follow-up and notably watching of the plantations (to prevent them against livestock roaming, and trespassers) is green rangers with the assistance of members of the groups.

Mixture of various indigenous tree species

For the Project, and as previously analyzed, mixtures of pioneer species and "climax" species is the basis of forest diversity rehabilitation; but little is (scientifically) known on such combinations and according to discussions held locally with local officers, there is little consultation with KFS on that issue; and no particular preparation on it, with specific recommendations or guidelines for the various sites provided to the groups by the Project.

For example in Geta forest site (42 ha planted), the mission made the counting of trees on a sampled micro plot (90 trees at 3 m spacing, on 612 m² - **see Figure. 3.).** Seven species were identified among the surviving trees with Olive tree and Cedar trees dominating by a bit more than 50%). The order in planting trees and their combination is entirely made by chance– as it comes by the planters, and depends largely of the numbers and availability of seedlings raised in nurseries. Olea and Juniperus spp, the most planted species in Geta forest block, are growing faster than the few Prunus planted , a "climax" species that is everywhere very much browsed by wildlife and livestock. Dombeya, on this site is showing a poor sanitary status and growth, although it is a relatively fast growing species on other sites.
The usual "pioneer" species that are the *Croton spp*, were not observed in this plot sampling; accordingly, the expected fast cover effect of such species will not happen on this part of the planted block, and probably beyond this area, whereas this could have been managed through appropriate guide lining on the mixtures along with short note and sketch (rationalized interspersing of pioneer and climax tree species, regular combinations, line by lines, etc).

6.1.1.11. Assessing tree survival, sampling and variability of results

The way the green rangers have been trained for measuring the survival of trees is based on representativeness of the sampled trees counted, at a sampling rate of 50%. Basically, on each newly planted block, one line every two is measured; or eventually micro plots of 20 holes x 20 trees/holes (approximately 3250 m² with a 3 m spacing) are measured according to a draught board design, viz. one staggered micro plots on two is measured.

This is largely enough, guaranteeing the needed representativeness of the planted blocks, and this rate could even be reduced, allowing to save time (but in return, counting survival of trees should be done by species, on appropriate forms, figuring lines and rank).

On Geta block, survival assessment made by the Green Rangers is about 75%, 4 months following the May 2009 tree planting. According to our sampling, survival appears a bit higher (81%), but close to 75% if we add the seedlings in very poor sanitary conditions (with little chance to survive)

As a whole, survival rates on the various sites planted are satisfying (>50 %) and in most cases good (> 75%), with the exception of the driest site, on Kikuyu escarpment (close to

Mayer' farm); this 6 ha block is seasonally invaded by the Maasai's livestock, and therefore heavily grazed and trampled (40% surviving trees, after 3 years).

Watching and defending the site against hundreds of livestock appears very difficult and is not effectively done; thus, one could suggest to fence such a block, at least temporarily (3 to 5 years) and as an experiment to test its efficiency. In addition to these constraints, some species initially planted were not suited to the site, not sufficiently drought resistant, such as *Juniperus procera, Podocarpus spp* and *Walburgia ugandensis. Croton* spp are the most trampled on trees, whereas *Acacia xanthoplea* and *Schinus molle* are perfoming well. Local *Terminalia spp* and *Melia spp* could be tested.

6.1.1.12. Number of trees planted in total and on different sites

As a result of the participation of the communities and their stake holders, the Project has managed to plant, from 2006 to 2009, a total number of 3,817,560 trees (see detailed figures per year in **Tables 12, 13 and 14**).

This is divided into two, where:
- 1,919,599 trees (about 1900 hectares) have been planted in public lands, and
- 1,897,861 (about 1800 hectares) have been planted in gazetted forests, of which the percentage has recently increased.

One may notice the high numbers of trees planted in public lands, initially much higher than on forest sites
- in 2006, they represented 54 % of all planted trees
- in 2007: 50% versus 50%
- in 2008 (long rains season) , they represent only 25%

This last figure is in good correspondence with the specific objectives (and component 1) of the Project.

A question remains regarding the conversion of the number of planted trees in public lands in hectares according to the ratio of 1000 for 1.
If this conversion of numbers into hectares can be accepted on forest site (in homogeneous blocks with a spacing of approximately 3 m x 3m), the operation appears tricky when trees are planted on single lines along roadsides or very much scattered in schools. In these cases, the number of hectares may have been overestimated;

Anyway, the target of planting 2,000,000 trees (about 2000 hectares) is largely reached as the total number of planted trees almost two times of this target., and achieved before the end of the Project. In that regard, the result can be considered as a very good performance.

A total of 1,353,072 seedlings planted in 2006 were validated as surviving in the forest and public lands. In 2007, 940,698 trees planted were validated as surviving in 2008
The total of surviving trees, about 2, 300,000, is itself overtaking the target after 2 years.

Figure 3: Species composition within the Geta forest block plantation

Total area planted in May 2009: 42 ha
Number of seedlings planted: 45 000
Survival rate (Project evaluation): 75 %

Spacing: 3 x 3m (equivalent to 1111 trees/ha)
Sampling: 90 trees on 612 m² (18 lines x 5 rows)

N°	1	2	3	4	5
1	Juniperus	0	Olea	Prunus	Juniperus
2	Nuxia	Nuxia	0	Olea	Hagenia
3	Nuxia	Juniperus	Olea	Olea	(Olea)
4	0	Juniperus	Juniperus	Olea	Olea
5	(Olea)	Juniperus	0	0	(Olea)
6	0	Olea	Olea	Olea	0
7	Olea	0	Juniperus	Olea	Olea
8	Nuxia	(Dombeya)	Olea	Juniperus	Juniperus
9	0	Olea	Prunus	0	Prunus
10	Dombeya	Hagenia	Olea	Juniperus	(Olea)
11	Juniperus	Olea	0	(Olea)	Juniperus
12	Juniperus	Prunus	0	Juniperus	Juniperus
13	(Dombeya)	Juniperus	Dombeya	Juniperus	Prunus
14	Olea	Prunus	Olea	Juniperus	Prunus
15	Nuxia	Juniperus	Ocotea	Hagenia	Olea
16	Prunus	0	Olea	0	0
17	0	Nuxia	0	Juniperus	Olea
18	Olea	Olea	Juniperus	Juniperus	Ocotea

Floristic composition (in %, from 73 surviving seedlings)

- Olea Africana : 38
- Juniperus procera: 30
- Prunus africana : 11
- Nuxia congesta : 8
- Dombeya africana : 6
- Hagenia abyssinica : 4
- Ocotea usambarensis: 3

Caption

- x : dead or vanished tree seedling : 19 %
- (species) : seedling in very poor sanitary condition : 7 %

Table 12: Number of trees planted and surviving in public lands and forests per constituency, in 2006

Constituency	Public lands			Forests		
	Trees planted, n	Trees surviving, n	Survival %	Trees planted, n	Trees surviving, n	Survival %
Gatanga	70,750	37,686	53.3	a		
Gatundu North	100,890	77,890	77.2	93,902	72,452	77.2
Gatundu South	48,640	16,033	33.0	53,398	37,567	70.4
Githunguri	5,314	3,328	62.6			
Kangema	19,875	11,652	58.9	b		
Kigumo	90,072	45,918	51.0	83,828	71,426	85.2
Kiharu	385,919	313,044	81.1	b		
Kipipiri	46,648	27,967	60.0	16,500	5,010	30.4
Lari	76,341	40,785	53.4	228,552	213,462	93.4
Limuru	61,269	56,414	92.1	358,730	114,810	32.0
Mathioya	135,467	105,740	78.1			
North Kinangop	31,900	22,007	69.0	68,650	54,031	78.7
South Kinangop	21,040	6,460	30.7	35,415	19,390	54.8
Total	**1 ,094,125**	**764,824**	**70**	**938,975**	**591,148**	**63**

[a] *Trees have not yet been validated in these sites*

[b] *No trees were planted in gazetted forests*

Table 13: Number of trees planted in public lands and forests per constituency, first and second semesters of 2007

Constituency	Whole year 2007			First semester			Second semester		
	Public lands	Forests	Total	Public lands	Forests	Total	Public lands	Forests	Total
Gatanga	154,050	7,300	161,350	58,951	6,200	65,151	95,099	1,100	96,199
Gatundu North	97,221	104,867	202,088	217	33,640	33,857	97,004	71,227	168,231
Gatundu South	65,621	75,695	141,316	1,900	30,000	31,900	63,721	45,695	109,416
Githunguri	4,174		4,174	2,909		2,909	1,265		1,265
Kangema	22,975		22,975	18,140		18,140	4,835		4,835
Kigumo	45,480	161,238	206,718	29,260	127,168	156,428	16,220	34,070	50,290
Kiharu	212,221		212,221	86,000		86,000	126,221		126,121
Kipipiri	63,821	44,170	107,991	50,987	30,591	81,578	12,834	13,579	26,413
Lari	36,706	162,500	199,206	8,360	118,000	126,360	28,346	44,500	72,846
Limuru	13,250	80,100	93,350	9,450	43,700	53,150	3,800	36,400	40,200
Mathioya	89,694	47,895	137,589	67,252	25,145	92,397	22,442	22,750	45,192
N. Kinangop	58,200	175,840	234,040		75,600	75,600	58,200	100,240	158,440
S. Kinangop	1,860	23,960	25,820	1,860	5,000	6,860		18,960	18,960
Total	**865,273**	**883,565**	**1,748,838**	**335,286**	**495,044**	**830,330**	**529,987**	**388,521**	**918,508**

2007 Survival trees: 940 698 > survival: 54 %

Table 14: Number of trees planted per constituency in public lands and forests, first semester of 2008

Constituency	Public lands	Forests	Total
Gatanga	1,800	15,247	17,047
Gatundu North	2,600	18,882	21,482
Gatundu South		130,900	130,900
Githunguri	1,122		1,122
Kangema	13,360	16,302	29,662
Kigumo	22,382	7,990	30,372
Kiharu	47,752		47,752
Kipipiri	200	47,000	47,200
Lari		88,700	88,700
Limuru	27,400		27,400
Mathioya	34,780	10,050	44,830
North Kinangop		11,000	11,000
South Kinangop		8,600	8,600
Total	**151,396**	**354,671**	**506,067**

Table 15: Tree planting events in the Aberdares Forest Ecosystem in April- May planting season, 2009, with the assistance of the Kenyan army

Constituency	Forest Site	Trees planted
Gatanga	Kimakia Site	15,200
Gatundu South	Kinale Forest	105,080
Kipipiri	Geta compartment 5	45,000
North Kinangop	Kipipiri West Biocarbon site	11,000
South Kinangop	Kamae East Biocarbon site	8,600
Total		**184 880**

6.1.1.13. Accuracy and constraints in collecting data on plantations

All the data given from the previous tables, extracted from the "AFD-GBM 2008 half year report", do not give any counting by species as this is not done in the nurseries, and requested to TNG. As previously mentioned, this lack of information is prejudicial to future good management of these plantations as well as to their assessment and improvement

It seems difficult for the Project to get up dated and detailed data on plantations sites and public areas. The following and inter linked reasons may explain this difficulty:

- the high number of nurseries planting sites and allied operations which represent a heavy load of tasks for the extension officers the green rangers and the green volunteers.. Each nursery (over 500) is planting in several forest sites and public sites, without mentioning the many plantations done at farm level. This results in a very high number of sites to be controlled each month (TNG) and at least two times a year, and of sites to be prepared (selection of the public sites to be planted, making holes, and all works related to planting and weeding).

- the logistical constraint. As the nurseries and the planting sites are scattered over large areas (each extension officer has to supervise a constituency), and transportation is time consuming and locally limited (long walking needed where road access is limited by bus or matatu), it is difficult for the extension officers and the green rangers to visit all the sites monthly. The time for transportation is lost for other tasks such as the follow up in nurseries and planting sites, but also for necessary meetings with stakeholders like KFS and other local operators that are essential advisers in the development of the Project;
- the capacity of the Project in assessing, prioritizing and organizing such tasks related to the plantations and their follow up.

6.1.1.14. Proposals to alleviate constraints in the follow up of plantations and data collection on their survival in time

A first and efficient way of solving the logistical constraints is to purchase, as soon as possible, motorbikes for the extension officers and bicycles for the green rangers. This will allow them to regularly visit, control and advise any work at nursery and plantation site levels; and therefore have more time devoted to other tasks, such as reporting, meetings and continuous professional training.

Purchase of motorbikes is certainly costly (about Kshs 250,000 each), but the budget of the Project seems to allow such an operation, including maintenance of the motorbikes (and purchase of bicycles). Another solution, discussed with GBM management, could be to purchase one or two cars (for example pick-up cars allowing the transportation of materials) and have them available on site, in a dedicated or central constituency and locality from where they could be used by several extension officers and green rangers, for their different field operations. But this scenario may not be easy to apply when operations have to be carried out in various distant sites at the same time, and remote sites may not be properly served. Anyway the issue is important, has to be discussed and solved.

Secondly, as soon as the accounting software and the geographical information system is fully operational, an operational link should be established between the nurseries database, the tree plantations database, the GIS database and finally the accounting database so as to allow all cross queries needed for the supervision of the Project (GBM monitoring and evaluation cell) and its biannual reporting due to the funding agency (AFD). This will considerably improve the follow up of the Project, made possible on a nearly month-by-month basis.

A third proposal that should be thought about is to simplify the assessment method of tree survival. This assessment which is the basis of the compensation system is inescapable; but the methodology used is a bit heavy, and it is difficult to apply it systematically in time on the many planting sites of the Project which are very much scattered. Hence, and without affecting the quality of the survival assessment, a new and simplified sampling method and plan, less consuming in time, could be tested. If this is not making a significant difference, one could envisage reducing the number of controls to one per year, along with an adjustment of the compensation system – in line with its proposed modification aiming at providing the TNG with an earlier first payment.

6.1.1.15. Amount of compensation paid to the groups

In return for appreciating what the community has done for the country, GBM has managed to provide a token of appreciation compensation to the groups and to assist them with inputs, notably, potting bags. The compensation is paid at KShs 5 for a seedling planted and viably surviving to six months. This requires a verification exercise after the six months, and hence planting of one year (which starts in the long rains of April/May) is compensated in the following year. In this way, the planting of 2006 has been compensated in 2007, and that of 2007 in the year 2008, and the figures for these years are available. So far then, for these two years, the compensation has amounted to a total of KShs 10 596 930: KShs 6 464 301 in 2006 and KShs 4 132 629 in 2007.
As a result of the long time that the compensation procedure takes, the figures for the planting of 2008 are not yet available (on going by October 2009). As discussed previously, a faster availability of this amount appears more important than the amount itself.
The last payments of the compensation will also have to be managed without too much delay after the end of the Project provisioned (following the last Project plantation). In this regard, some provisions may have to be done by GBM and for discussed with the donor, in this perspective.
Finally, without ignoring how critical is the issue of accountability, which requires accurate checking and records which are time consuming, and without changing the principles of the system, it seems needed and possible to improve it.

6.1.2 Relevant skills introduced in communities for tree planting and protection, and related issues

It is due to the good technical skills given on tree planting that the groups have been able to keep neat and flourishing nurseries –for most of them- , and raised so many seedlings enough to meet the Project goal and surpass it, even in hash climatic conditions like the drought of 2009. In this, the Project gets a good score as well. These skills will remain in the community for a long time past the Project life and it is a commendable contribution to the country, both in the short and long term.
To maintain high this level of skinless, and eventually rise it, refreshers courses could be more frequently organized, in situ, allowing to gather larger numbers of groups and have them sharing experience and more interacting in the place of their nurseries.

6.1.3. New livelihoods promoted for the sustainable use of forest ecosystem, especially for women

Promotion of alternative livelihoods was seen as a good accompanying strategy to tree planting as a way to prevent a situation where people would be driven by poverty to prey on the same forest they had rehabilitated. In our assessment training given in this respect covered food security, and income generating activities (IGA). However, we could not find

evidence of a systematic training program on these issues, and from what we could gather from the extension officers and the communities, little effort was spent here as compared to tree planting. For that reason, very few groups had practiced new innovations in food security or started income generating activities. Of the 12 groups we interviewed, only 2 (about 16%) had started some IGA (bee-keeping). In other information provided by the GBM, about 100 groups in total had some form of IGA, which would represent about 19% of 516 groups in the Project. However, it must be noted that the Projects that are in GBM records as IGA are not real income generating activities; they are such as merry go round activities (here members just revolve their own money between themselves without necessarily multiplying it, that is without making a profit out of it), buying shares (not actual daily trading but keeping them to appreciate value over time, which always does not happen and ties money,). An IGA is meant to be a micro continuous enterprise that multiplies its owner's capital through making profit/interest,

According to the logframe, it was envisaged that the enterprises started would be innovative in bringing in the aspect of sustainable utilization of the forest resources. This aspect has not been very well achieved: the list provided to us includes only about 10 % of the groups as having an enterprise that could meet this criterion, that is, bee-keeping.

On the overall, on the indicator of supporting new innovative micro-Projects for sustainable use of the forest resources, the Project cannot be said to score well. Much more effort needs to be applied, and also following a well designed strategy of IGA promotion. As this resource does not seem to be adequately there in GBM, the same could be pursued with the advice from short term expertise.

6.2 Public and institutional awareness and training dissemination and communication (component 2)

The expected outputs of this component are as follows:
- New consciousness in the communities for sustainable forest ecosystems management;
- Environment friendly and sustainable forest management public policies promoted;
- Outcomes of a watershed forest rehabilitation pilot Project disseminated throughout the remaining four water towers of the country and beyond.

6.2.1. New consiousness in the communities for sustainable forest ecosystems management

6.2.1.1. From awareness to group mobilization, formation and their training

GBM works through village level self help groups, of which it has about 4000 throughout the whole country.These are community based organizations (CBO) that are formed around certain needs by members of a community. Typically, the groups have between 10 and 50 members. An example is the merry-go-round scheme (or "tontine"), where members of the self help group contribute money for each member in rotation, and the members can use this money for various needs, such as paying school fees, meeting medical expenses, buying household utensils, etc, or investing in a business. When the GBM extension officers go on

ground, they identify these groups, and start to interest them in environmental conservation. When a group decides to join GBM, it first registers with the Ministry of Culture and social services as a CBO, and armed with the registration certificate from the ministry, it then registers as a Green Tree Nursery Group with GBM. From there it undergoes training in environment conservation, tree nursery establishment and management, tree planting, GBM values, etc, through the GBM Ten Steps Procedures. Each village may have one or more tree nursery groups (TNG). For ease of administration, training and mobilizing critical mass for action when necessary, the groups get congregated at sub-location level into a network. Each network is under guidance of Green Volunteer (GV), but the internal affairs of the network are guided by a committee of representatives from the groups, which have its executive (chairman, secretary, treasurer). The Extension Officer oversees all networks in a constituency. As a network, the groups also undergo through leadership training following a Network leadership training manual. During the leadership training, other contents on food security, income generating activities, advocacy and reporting are delivered.

The trainings are delivered on a modular basis, with the Extension Officer/GV visiting each group at least once a month for purposes of monitoring and training, until the group is well matured. At that point, the group can be used a focal point for training other new groups in the network, or other nearby networks, with its site being used as a demonstration, and even some of its members playing the role of resource people.

Where necessary and possible, the groups assemble together as a network for training. Hence, by the time a group is two years old, it will have had about 48 contact days with the Extension Officer/GV.

In our estimation, the GBM groups have been very well mobilized. The grassroots organization through groups, networks and constituencies seems to work well. The mobilization message of tree planting for environmental conservation has been well understood. The groups have internalized to a high degree that there is a need to replant trees in the degraded forest areas. They can easily connect tree planting with environmental conservation, and the resultant benefits such as improved climatic conditions and water retention, increased water in the rivers and other sources. They are willing to join hands with others to work towards this end.

6.2.1.2. Number of Tree Nursery Groups and Networks constituted and groups commitment

Quite a commendable concentration of groups (516 TNG in total in 104 networks representing more than 7500 households) has been mobilized, on a voluntary basis, throughout the areas surrounding the Aberdares Range. This number is almost two times the number of groups envisaged to be recruited (280).Hence, this is a very good performance. Such a mobilization has been the driving force of GBM since 32 years, and explains its success.

Meanwhile, one may note, through the **Tables 7, 8, and 9**, that 48 TNG (almost 10% of the 564 initial TNG) left the Project since 2007. In accordance with replies given to the consultancy mission through a rapid appraisal survey with TNG, this drop could be due to the discouragement of certain groups: when facing successive droughts or difficulty to get water and raise seedlings or disappointed by the long time they have to wait in receiving the

compensation grant – which appear very marginal when the cropping season is a failure and food security the priority for farmers (who initially stuck to the "token spirit" of this compensation).

From our interaction with the sample, the groups have a strong sense of belonging to the Green Belt Movement and they feel they are playing an important function in the nation's development. There is a high spirit of voluntarism, which drives the groups to endure a lot of difficulties. They manage a lot of difficult work patiently with only a token payment of appreciation. They have experienced that the compensation they get from GBM is just a token of appreciation, and that it cannot pay for their effort, but they still continue to give their effort and resources. They seem to be driven by a strong belief in the return to a better, greener country. The core values of GBM have been well instilled to a very high degree. And one may consider the TNG as the kingpin of the movement and of this Project in particular

6.2.1.3. Women involvement

Women have traditionally been a good response group for GBM work. In this Project, they seem to be the majority in the tree nurseries. Although no statistics have been kept on this, going by a sample of five groups we interviewed (Matatu Operators, Kwaregi Network, Nyamweru, Mikaro Bee-keepers, Jembe), women were about 60%, thereby largely outnumbering men. The ratio underlies the keen effort of GBM to bring women as key participants in environmental conservation, since they usually bear most of the burden resulting from environmental degradation (e.g. difficulties of getting firewood).

6.2.2 Environment friendly and sustainable forest management public policies promoted

6.2.2.1. Promotion of community based management of forests, and related partnership

The Project, in its approach has sought to work with government stakeholders and many other international agencies so as to bring a concerted effort to bear in the long term rehabilitation of the ecosystem. To start with, the work of GBM in the past has been instrumental in bringing about governmental change in policy, with a shift from strict line ministry control of forest and water tower conservation, in favour of working with NGOs and communities. The new Forest Act which promotes a community based approach for the sustainable management of forest, along with new rules and regulations, owes a lot to the civil society lobbying, and notably to GBM.

In this framework, GBM has been able to get a memorandum of understanding for partnership with the KFS, the KWS and others, and this set of partnerships was fruitful in implementing the AFD Project. The KFS has been involved in providing the communities with advice on tree species selection, providing the planting sites in gazetted forests, providing transport at certain times and will continue to care for the trees beyond the Project period. Even now, they provide the GBM green rangers much needed support. The KWS provided security in places of its jurisdiction. Among other partners, the Kenya army provided transport and labour to assist the communities in mass planting some sites. Other players, such as the Ministry of Water, the Water Resources Management Authority, and the

World Bank have all been part of the consultative process for this Project and have contributed to shape its design and methodology.

6.2.2.2. Local Coordination Unit action

In the same thrust, the GBM Project has recently organized 5 Local Coordination Units (LCU) covering the 13 Constituencies of the Project area. A LCU being composed of local leaders and representatives, and allowing to gather most of the concerned stakeholders, it is acting as local steering committee and provides room for strengthening partnerships, and promoting concerted actions –such as events axed on tree planting and forest rehabilitation (See list of LCU in **Table 16**).

Table 16: Summary of Local Coordination Units of the Project

LCU	Constituencies	Date	Participants (N)	Venue
1st Unit	North Kinangop	23rd June 2009	16	Ndunyu, Njeru, North Kinangop
	South Kinangop			
	Kipipiri			
2nd Unit	Lari	22nd June 2009	16	Limuru Town
	Limuru			
3rd Unit	Gatanga	29th June 2009	15	Thika Town
	Gatundu North			
	Kigumo			
4th Unit	Gatundu South	17th June 2009	12	Gatundu Town
	Githunguri			
5th Unit	Kangema		12	Muranga Town
	Mathioya			
	Kiharu			

The LCU meet every three months for purposes of steering Project implementation activities in their respective localities.

6.2.2.3. The Project and the newly established Community Forest Associations (CFA)

Right now, the move is for the communities to be more involved in environmental conservation through, Water Resources User Associations, Community Managed Wildlife Conservation Areas, and Community Forest Associations. All these have a conservational role, looking at trees, water, soils and biodiversity. In our interaction with the relevant authorities, GBM is strongly identified to be a key player in all these community initiatives and processes, and its members, who are already well mobilized and trained on conservation are likely to be key drivers. For example, we found out that the Chairman of one of the GBM groups (Hikahika) was also the chairman for Geta CFA, which is in its formative stage.

It must be realized also that GBM had thought up a design to congregate all networks in a Constituency to become GBM CFA. However, this did not work out as such, because of the regulatory requirements for the CFA to be institutionalized within the structure of the KFS,

and GBM networks now join the CFA, formed under the midwifery of the KFS, as user groups. As part of its collaboration with KFS, and as written down in the MOU it signed with KFS, GBM has been involved in fostering the dialogues for formation of four CFA in the Aberdares and writing up of their Management Plans, that is, CFA for: Gatare forest, Geta forest, South Kinangop Forest and Kimakia Forest.

Hence, achievement on the part of promoting public policy, including its new Forest Act applications, through CFA support, can be considered to have a very good score.

6.2.3. Outcomes of a watershed forest rehabilitation pilot Project disseminated throughout the remaining four water towers of the country and beyond

6.2.3.1. Dissemination of results, Project visibility and replicability

Basic dissemination and visibility

Professor Wangari Maathai, the Coordinator of GBM has been very much in the forefront of presenting need and urgency for conservation of the country's water towers and the environment in general, both in local and international forums. In this, she has been very successful. GBM has developed a website, which quite well captures much of her features in this lobby/advocacy work. But although the global messages go in to support the AFD achievements, and application for the other water towers in the country, the website does not contain materials specific to the AFD Project

Hence, the expected disseminated outcomes of the Project, throughout the other water towers of the country, notably sharing experience is one of the non achieved outputs.

This lack of communication of activity and results on Project, and interaction with other water-towers is linked to the delay in the development of the GBM web site and dedicated web pages. As a result web site visitors cannot get a minimal information on the Project and share its experience and the visibility of the Project, is poor

As the Project duration has been extended by one year, this missing output should be addressed without delay before the end of the Project.

Other outcomes: studies and materials to be developed

According to the feasibility study, on the issue of advocacy/dissemination, it was appended several studies and materials to be developed, notably:

- A hydrological study which will gather the current knowledge about the influence of the forest cover on river flows and water resources;
- An advocacy study about the linkages of natural resources and local livelihoods, which will demonstrate the benefits of the forest ecosystem sustainable management.

We were made to understand that these two were in implementation stage in way of baseline study and socio-economic study:

- Specific school sensitization operations for children,
- Creation of specific public awareness documents and tools,
- Launch a video-documentation at the end of year two, as soon as the first tree plantations are set up.

The school sensitization program has been ongoing, and there is a civic education manual that has been adapted for public awareness. The video documentary is also in the production stage. Hence here, the organisation has put commendable effort

Replicability and scaling up

In its design, the Project methodology is simple and easily understandable by the target groups and other stakeholders. Its importance and priority/urgency for the country is underscored both by the collaborating implementing governmental institutions (KFS, KWS), the policy making echelons and the donors, in the context of the fact that conservation of the five major water towers of the country has taken a great national priority and international interest. It is therefore a Project that has high replicability in other areas.

Expanding the current operations to other places in the Aberdare and the adjacent Mt Kenya would be a logical and (possibly) cheapest way of replicating and scaling up of the Project, since one would be working with the same geophysical area, the same socio- ethnic community, etc. with ready application of lessons learned.

Of particular interest would be the Mau Complex, where soon the envisaged eviction squatters will leave a large area of land requiring to be reforested. GBM could have a stake here, and despite the fact that the Mau situation is rather highly politically charged right now, we believe that sooner or later, the high political charge will dissipate and the situation will then be ripe for the civil society to address.

6.3. Project management and monitoring

Component 3 was delineated as the Project management and monitoring,
This component was beset with hiccups at first, especially because of the lack of right senior personnel for the Project, to deal with financial and administrative aspects. After some time, a capable Project Officer came on board, and the Projects oversight was enhanced by the employment of the Finance and Administrative Director to take charge of the financial and accounting part of the Project operations, with other operations of GBM.

It is important to note that a Programs Management Committee has been put in place. Furthermore, the Project did produce an Implementation Manual to guide procedures and relations with AFD. The GIS has also been strengthened and adapted for monitoring the Project, and a system is now being installed that will integrate the financial system with the field monitoring operations and payment systems. Since the engagement of a Project Officer and Finance-Administrative Director (now Acting Executive Director), reporting to AFD has been adequate, and has reached a level where all the required reports and returns are made in time, another plus for the Project. Hence, by this time, one can see a commendable achievement on administrative issues.

Despite the above, when it comes to timely expenditure of funds, the Project does not score well.

One test of Project performance is to assess whether funds were applied at the planned time to produce the intended results. It seems that as far as tree planting process is concerned, GBM performed quite well. Just looking at some four inter-related aspects of this, in the 2009 budget period, by the first half of the year (January to June), the expenditure picture had been accomplished with an average of 64%, as follows:

Local networking and mobilization of institutions and leaders	87%
Mobilization workshops and capacity building of members	33%
Conduct tree planting days for the community members	53%
Provision of planting materials and tools	84%
Average	**64%**

This was good, and it is as would be expected, since most of the effort on promoting the tree planting activities need to be done in the first half of the year, to enable time for the impetus produced to be put into action in the later part of the year, and to take advantage of the April-June long rains season.

However, when it came to the related activity of compensating for the seedlings for 2008, the performance was not good. It would have been expected that this would be more or less fully accomplished by June, according to the time limits of 9 months set out in the feasibility study, but only 35% of the funds had been used.

Further, the somewhat bright picture becomes a bit tarnished when one looks in detail at the expenses of the Project at half-year 2009**.**

It can be seen that by that time, there are a lot of activities that had not been implemented (0% use of funds), or implemented to a very low level. On the overall, the average usage of funds in those 6 months for all the activities was 16%, a very low performance. This means that GBM is delaying application of funds to various activities; this explains why the Project carried forward from 2008, a balance of KShs 11,864,277. While it is appreciated that some activities would usually be implemented in the later half of the year, such as financial audit, overall coordination and general charges, it would be expected that by the first half of the year, the major implementation aspects have been put in place to a large extent (giving an total implementation average of up to 60%), so that the in the later part of the year, there is no rush especially considering that December is a holiday month, and forestalling a situation where funds have to be pushed to the next year. The above picture therefore puts a low performance score on the timely application of funds and timely implementation of all planned activities.

6.4. Summary impacts

The impacts from the above discussed achievements can be summarized as follows:
- A large section of the community in the Aberdare region have truly adopted -environmental conservation, and it can be seen that due to the great inspiration created, they will continue to commit in the long term ;

- The Community have learned how to organize themselves effectively for large scale public enterprises and how to network with stakeholders on the same;
- Community have acquired skills in nursery and planting techniques that they will continue to use for a long time for the good of the country, and Aberdare area notably;
- Trees have been planted on degraded forest sites and public lands. Actually, at the early stage of development of these trees, this is a modest contribution in terms of rehabilitation of the water catchment capacity of the Aberdare. Expected impact on water conservation will depend on the survival of these trees when mature and fully functional, individually and as an ecosystems - but in any case this impact is difficult to assess
- The group members have planted trees in their farms. These will in time provide them with firewood and timber. Also it will assist in soil and water conservation in their farms;
- A pool of well trained extension is in place. These officers will continue to be available for GBM work and for other NGOs in the country, working for the nation
- The group members have been able to pay school fees with the compensation money and also provide food to their families even if for short periods
- Some groups, albeit very few, have started income generating activities and the income will go to improve their families' welfare.

PART 4: PROPOSED ACTIONS FOR THE EXTENDED ONE YEAR OF THE PROJECT (2010)

In the perspective of the additional one year of the Project, agreed with the donor, the following methodological and technical priority actions are proposed aiming at alleviating certain difficulties, improving the performance of the Project and notably boosting the production of expected outputs, both at field and GBM management levels.

For all identified priority actions, one or more proposals are given following a briefly summarized diagnosis of the situation. Implementing these proposals is a matter of decision, for immediate action in most cases, although they represent different levels of investment and (iterative) efforts.

7.1 Adjustment of the compensation system

The compensation system is based on surviving of seedlings and is engaged 6 months after planting (first payment of KShs 5) followed by successive payments of KShs 2 at 12, 18 and 24 months. It was recently increased by a modest one shilling (11 KShs instead of 10 per surviving tree), and although it has to remain a token, this amount appears lower than before considering the TNG efforts in providing important inputs such as potting bags, tools, fertilizers and pesticides whose prices have increased a lot. External factors, such as over grazing or destruction of seedlings by livestock, out of the responsibility of the groups make for them the task difficult.

But more than the amount of the token, the delay in the payment of the first instalment, after checking of surviving trees and accountability, is frustrating most of the groups, and has an effect on their motivation and mobilization.

Proposal: GBM to adjust the compensation system so that a first part of the KShs 5 usually paid after the survival count and verification is immediately paid after tree planting (proposed KShs 3), and the second part is paid after survival counting and checking (proposed KShs 2).

7.2 Provision for 2009 and 2010 compensation, use of funds in time

The GBM Project will be completed by the end of 2010; at that time, the compensations due for 2009 and 2010 would not be yet paid or even accounted –as a result of the procedure and long time the system requires in its current application**.**

Proposal: GBM to make provisions of funds for the payment of 2009 and 2010 plantations, and make a decision for adjusting the system, in consultation with the donor, and managing in time the final payment due – if not accelerating it, not beyond 2011. So the groups will be paid with minimal delays and confidence in GBM activity be firmly kept.
Generally speaking, one may remind the Project commitment in the use of funds in time, viz. to adhere to timely application of funds, so that activities are implemented in time – including certain proposals in this chapter- and no funds are carried over to next period.

7.3 Income generating activities (IGA), pilot studies and training

Income generating activities (IGA) are part of expected outputs of the Project but have been little addressed. Groups start IGA on their own, sometimes with NGO and stakeholders' assistance. Lack of money/ seed capital and experience may be a constraint to start IGA. Hence, any IGA proposal has to be seriously studied before agreed. Through ad hoc micro-credit scheme, and in relationship with dedicated use of compensation, IGA should contribute both in environmental conservation and livelihoods, and in a sustainable manner.

Proposal 1: diagnosis and design IGA study
GBM to make an analysis of what IGA their members are in, the status, challenges they are facing, what assistances they are getting from other agencies, and what would be the likely assistance gap for GBM to strategically fill and what are the priority sectors (through surveys, rapid appraisals, etc) : e.g. biodiversity-bee keeping, insect rearing such as butterflies, herbal orchards/herbal gardens, etc, or high value products using water conservation technology e.g. green house tomatoes, drip irrigated vegetables, etc, or utilization and protection of the water source, e.g. fish keeping in the streams, or high value with soil conservation, such as organic gardening, etc. Such a study (diagnosis and design type) could be carried out by an external expert.

Proposal 2: training of group members on IGA
On how to start up such IGA: concepts and applications, specifications or requirements, including financial and organizational issues, registration, technical backup (production aspects, processing of products, storage and quality issues, etc), and marketing issues (access to market; transportation, etc.)

7.4 Initiating a micro-credit system, in relationship with compensation

Although amounts of compensation paid are rather low, and beyond the fact that this money is often used to pay food and school fees, part of compensation is frequently used as investment in private or common micro-Projects of the groups. It could be boosted through adequate financial support (loans) in addition to compensation invested by the groups giving them (women, youth…) an opportunity to get returns and cash.

Proposal: Take advantage of the proposed adjustment of the system and bridge it with micro-credit system for the groups on a pilot basis. A few groups could be selected for the pilot, in an area where the groups are well matured and working with minimal problems. Payment of the compensations made just after tree planting could be conditioned to re-investing in innovative activities; further payment(s) of the compensation could serve as a guarantee for the reimbursement of the loan.
Experts could be hired on the matter (to study the conditions of promoting micro-credit, and more generally income generating activities, the Project is committed to).

7.5. Membership evolution and youth mobilization

The disengagement of the members of certain tree nursery groups is observed, in particular with the closing down of the young people whose numbers are now very low,

compared with the women (dominant) and senior men and women that make the TNGs. Accordingly, as an average, TNGs have an active membership of only 50% or thereabout, after being in existence for some years. The low and late payment of compensation and disappointment for certain members may explain the reduction but this may not be the only reason, and appropriate explanation and re-mobilization of TNGs may be needed.

Proposal GBM to conduct a detailed analysis of why its groups are losing members and how the youth can be attracted to GBM work, and its Project. Regarding the youth, , strategies to attract them have to be explored, from responsibilities given to them, for example, offering positions of green rangers and nursery attendants that many nurseries very much need – to appropriate training They also have to be enrolled in possible IGA initiatives, and entrepreneurship integrating business and environment issues.

7.6. Programme officer recruitment

Many reflections need to be launched on global and federating issues of the Project and certainly of others addressing similar challenges within GBM: integrated management of watershed concept is a major one; and experience sharing and knowledge capitalization is similarly a very important "transversal" action to be initiated and coordinated. In this perspective, the Programme Officer, which has been scheduled for long time, has a lot to do.

Proposal
To recruit without more delay the Programme officer the Project (and as a whole GBM) needs. One of his first action could be to (co-)organize a workshop on community based management of forest plans that constitute an entry point for further GBM and CFA activity in gazetted forests, buffer zones and corresponding watersheds.

7.7. Strengthening the Steering Committee (SC)

As previously analysed, the Steering Committee of the Project is currently not fully operational; minutes of the SC meetings appear limited in terms of reviewing key points (progress, bottlenecks..) and expected guidance (steering); therefore this SC needs to be strengthened.

Proposal: a revamped Steering Committee with high level representation and full commitment from GBM, donor and government have to be searched for, to notably boost advocacy mechanism, as well as to present the lessons learnt, develop partnerships, and consolidate actions -in addition to the need to provide the Project with critical appreciation and elaborated guidance for its best development in its final stage. In this perspective, appropriate documents and agendas have to be sent in time to the SC members for the next meetings
Discussing the results and proposals of this report/mid-term assessment of the Project should constitute a priority in the agenda of the next Steering Committee.

7.8. Defining and implementing the socio-economic study

A socio-economic study has been scheduled since the inception of the Project; it remains to be carried out without more delays by the end of 2009 or beginning of 2010. Such a study is of major importance for the Project, as it should allow to better understand the social and economic organization, activity, modes and functioning of the groups and stakeholders involved more or less directly in the management of natural resources and notably in tree plantations and rehabilitation of forests and watersheds, in relationship with their developmental needs, and livelihoods.

Proposal 1 : the socio-economic study is to be properly defined in the coming months, taking into account the results of this mid-term evaluation of the Project. In its TOR, it could include the following points:
- to assess the efforts of the groups in raising time and money to establish the nurseries and to keep them running well, and to plant trees, and take care of them
- from this starting point, to determine the net monetary value/outflow from the groups to the tree planting activity for social good. This information would be useful for arguing out issues on designing policy on community led environmental conservation:

Proposal 2: In this framework, one could suggest a complementary study on the impact of on-farm tree planting done during the first phase of GBM – within the Project area, or possibly extended to other Projects dealing with the same global objectives. For example assessing the impact of *Eucalyptus spp, Grevillea robusta* and indigenous species on the livelihoods of farmers as well as on the environment, with the objective to promote the organization of small farmers/tree planters so as they get the maximum returns from a rationalized and sustainable exploitation of their mature trees.

7.9. Reflections on tree plantations and watershed issues

Project objectives focus on watershed rehabilitation through reforestation.
But the approach and activity employed to reach these objectives are not fully operational: for example, more trees have been planted on public sites (versus forest sites), articulation between water issues, tree planting and GIS tool is weak, and as a whole, reflection on watershed issues through ad hoc tree planting and allied soil and water conservation techniques is missing – whereas this could be discussed and properly justified in organizing tree plantations and planning their future management (from site and species selection with corresponding germplasm to adequate tree combinations and management of plantations).

Proposals: initiate meetings or workshops to develop the reflection on how to appropriately manage the plantations and rationalize the choice of the species with regard to site conditions (basic characterization and detailed specifications) and tree combinations in good knowledge of species growth and possible competition effects.
Another reflection is needed regarding the (spatial) reality of watershed concept and integrated management, including soil and water conservation technology –notably through tree plantation, and within well delineated (sub-) catchments. Various stakeholders and partners such as Nature Conservancy should be associated (bridging

community approach and watershed management). It could be extended to the design of integrated land management with concerned local communities and stakeholders (at village or location level) with the perspective of harmonizing developmental and conservation issues (trade offs at the interface between nature and societies)
In this framework, the GIS tool has to be fully operational (not yet the case) and be systematically used to integrate and map watershed and plantations entries (data), and facilitate action (selection of planting sites for next seasons, follow up and management of previously planted sites, etc)
Finally, such a reflection would facilitate the preparation of Forest management plans involving CFA and stakeholders in application of the Forest Act, allowing GBM to reinforce its action, and make the voice of CFA listened to.

7.10. Strengthening methodological and scientific basis, assessment and dissemination of results

Methodological and scientific basis in tree planting and management, along with rationalized approach and reflection regarding watershed issues are weak or insufficiently developed by the Project; beyond global survival, no detailed results (simple measurements and observations) on the behaviour and growth of the many indigenous species planted on various sites have been registered, analysed and used for management of the current plantations and guidance of future ones. In this framework, simple observatory plots if not experimental plots can be designed to assess tree species performance within and between sites.

Proposals:
GBM to initiate a systematic collection, analysis and classification of relevant field data and information and to design a workable approach for dissemination and sharing

- Data collection, review of literature: the first step is to collect relevant information and analyse it within minimal time. Information includes preliminary field data collected from the Project and data from literature from which systematic review and analysis is to be developed (on tree species, their environment and management, etc.). Field data should be confronted to bibliographic information allowing to compare (confirm or contradict) results obtained in various contexts, and therefore to provide guidance for next planting seasons
- Field measurements and observations on trees: At the same time, a methodology for measuring trees should be designed and applied with the support of concerned research and development stakeholders (University, KEFRI, KFS…)

Basic and regular observations and measurements of trees (height, health status), are to be put in place through ad hoc sketches and forms for assessing and monitoring both environmental conservation and socio-economic impact of the Project -so that through such a reliable information system applied over time, an appropriate follow up of the plantations on medium to long run be satisfied, along with solid results for the design of other plantations, and extension on other sites.
In this perspective, students could be associated in field data collection, and management: from the experimental design for measuring trees (sampling, types of observations and measurements, agenda, etc) to computerization and analysis of data they could work on particular species, and sites, measure trees in oldest plots, and

assess their performance, and finally contribute to selection process of indigenous trees on dedicated sites and corresponding germplasm (access to potential seed sources, etc). Tree species could also be studied in terms of susceptibility to weed competition, browsing, and fire; and finally in terms of capacity to grow in mixed plantations.

Identification of MSc (and possibly PhD) studies, could be explored with the university of Nairobi: for example axed on the ecology of important/threatened indigenous species and related forest ecosystems, biology of their reproduction, etc.

- Observations and measurements in nurseries:
The priority is to assist the TNG to improve their nursery records to include details of types and numbers of seedlings raised, income and expenditure, work records, challenges being faced, and so on in line with the technical issues raised in the report
Secondly, studies and simple trials could be developed through the contribution of under graduate students (in Forestry), notably on: seed conservation, seed pre-treatment, nursery practices and maintenance, germination and early growth, root and stem development and management to guarantee the best results in seedlings production, and improve knowledge on the management of indigenous germplasm.

- Data analysis and valorisation of results
Computerization of data has to be done in good accordance with the development of the GIS and its relational data base. The interest for such a tool will be considerably strengthened thanks to the many original field data on trees the Project could enter, in addition to all basic data characterizing the area and the sites (altitude, climate, soil, etc). For example, spatial analysis of tree performance (survival, growth), could be done for major indigenous species planted in the various site of the Project area
Disseminating the results the Project, through communications given at workshops, (and pages on web site) and publications is to be initiated so as to share these results with others and contribute to publicize GBM experience.

Finally, environmental and socio-economic indicators could be defined through data generation and analysis for the monitoring and evaluation of the Project –and other similar Projects.

7.11. GBM external and internal communication

Although the conceptual approach of GBM is well developed on its new web site, there is actually no information on the Project. Accordingly, the international community (including scientists and donors) cannot be reached easily, the Project is little known, and needed interaction with others (Projects, civil society, etc) is limited - affecting in return GBM visibility and image.
On internal communication, beyond the regular exchanges and information shared through meetings the Project is having with the local staff, the groups, and its stakeholders, there is no permanent way of communicating in the form of medium of communication between the local level and the Project and GBM management level.

Proposal 1: to reinforce it external communication, GBM has to develop the missing web pages on the Project –possibly by contracting a web expert- and display its main results (following a short introduction on the Project: objectives, activity, expected outputs…) with

appropriate iconography (photos, maps, etc). Other communication tools, such as a short video film, could be produced and integrated to the web site/dedicated pages of the Project

Proposal 2 : on internal communication side, it is recommended to develop with local groups and staff a newsletter in kikuyu, aiming firstly at sharing their experience (nurseries, tree planting, etc), improving some technical and organizational aspects, and reinforce the spirit of the groups membership, and secondary at informing them on various issues from GBM and stakeholders. A four pages quarterly grassroots newsletter (or bi-annual to start with) is proposed. It should be developed with EO and GR contribution in collecting local information, writing up short articles to be submitted to the Project, for revision and insertion in the newsletter. A consultant may be needed to design this proposal, taking into account the previous GBM newsletter, GreenNet.

7.12. Training and capacity building

Training and capacity building are major components in GBM activity and the Project in particular. GBM has a training centre in which the formations are essentially centred on advocacy, civic education, food security, and "women and change"; but it seems that there is not enough technical training, despite the fact that extension officers (EO) are forest professionals. More training materials and pamphlets are also needed, both for the EO and the TNG that they train

Proposals
- improve EO training by integrating to the course topics of relevance to the Project such as integrated land management, at watershed scale, socio-economics and the conservation of the environment in sustainable development, etc. and ii/ including refresher courses on silviculture, management of plantations, etc. that could be organised with KFS and KEFRI support;
- design an improved curriculum for the tree nursery groups on tree nursery techniques to reflect the technical issues raised in this report and articulate this in a TNG Training Manual (from nursery creation and maintenance, to tree planting, seed collection, including soil and water conservation techniques, etc. and incorporating the Ten Steps approach);
- along with the production of a practical do-it-yourself pamphlets for TNG, hence written up in a simple language and illustrated with many explicit drawings and sketches
- EO and TNG to be re-trained using the new curriculum

Editing of training materials and pamphlets would need a consultant, taking advantage of the many materials produced in Kenya by other Projects or programmes.

7.13. Technical aspects, at nursery and planting sites levels

Significant technical improvements at nursery level as well as at plantation level are needed and possible at one year scale. These technical improvements are detailed according to the following sectors

- seed and germplasm collection, seeds quality and management.
- seedling production in the nursery, including water harvesting and management.
- Some other nursery and planting practices including the management of roots roll up in the nursery that can induce failure in plantation stage
- protection techniques against browsing (for example, in escarpment site)

Among these recommendations, one is to be considered as a priority, when considering the successive droughts and difficulty on many nurseries in accessing water:

- GBM should provide a minimum of water equipments that the TNG cannot afford: water tanks and pipes; and in some cases water pumps; other tools be considered.

A second recommendation concerns the recruitment of nursery attendants for some nurseries –at least the biggest ones- should have such a person, considering the quantity of continuous work such nurseries require, and which the groups cannot satisfy in many cases.

PART 5: FOR THE FUTURE - PROPOSALS

In continuation with the current Project, viz. in line with its main objective of watershed rehabilitation through tree planting, and taking advantage of gained experience, it is proposed to deal with the full watershed and apply to it an integrated management approach, of its various components, of environmental and socio-economic nature –beyond the strict Aberdare forest ecosystem.
As effectiveness of water catchments are function, in a global overview, of land use variations, the watershed itself may be considered at any of its unit or sub-unit - catchment or sub-catchment- scale on which a model of management could be developed and serve as a pilot Project for other watersheds or water towers of Kenya, through up scaling and necessary adjustments.

8.1. Integrated land use & watershed management: from needed improved approach to feasibility study and pilot Project

8.1.1. Context, rationale and priority entries

The Aberdare range is made up of three successive zones, along the toposequence:

Zone 1: the high elevation central area topped with the *National Park.*
It is now protected by the electric fence and thus should be efficient in its ecological functionality and as far as its watershed and upper catchments of main rivers (Tana, etc) are concerned. The impact of its protection should increase with time, through the rehabilitation of its natural resources and notably of a climatic vegetation and corresponding biodiversity.

Zone 2: the *Gazetted Forest,* surrounding the *National Park*.
It will be soon subject to Participatory Forest Management Plan, viz. providing an appropriate framework for community based and sustainable management of the forests, through MOU to be signed between the CFA and KFS. Although implementation of such a plan will certainly have to be adjusted, local populations should be able to contribute to the protection of the forests while benefiting from them through harvesting of various (mainly non-wood) forestry products. If returns are significant in terms of benefits for the local population, one may expect a reduced pressure of human activities on forests: less over grazing, less wood cutting (timber, firewood, etc.). Accordingly, re-growth of the natural vegetation (secondary, pioneer species) should be able to recover large parts of degraded gazetted forests and this regeneration -in addition to tree plantations- should have, on the medium to long run, an impact on water conservation (retention, release, balancing)

Zone 3: the *Farmlands,* from the forest line to the lowest slopes of the Aberdare
It is the largest zone which was extended at the expense of the forest for decades. Meanwhile, in that zone and thanks to GBM impetus that was initiated 30 years ago, farmers have been planting many trees in their croplands in the form of various agroforestry systems (on boundary, contour lines or interspersed with crops). Extension work has also been done in soil and water conservation techniques by other parties –to notably prevent soil erosion. Although no impact assessment of tree plantations on soil and water status has been done, one may assume that these trees have a positive effect (both individually and collectively) on water infiltration and conservation, thus on water catchments -although it could not be as

effective as a close canopy forest, unless a global land use and watershed management is instituted.

These zones are fully interconnected, notably through the hydrological network.
This is why a global land use and watershed management, integrating these different zones is to be promoted and effectively applied. Hence, on short term, the challenge will be to properly bridge under this management the forest and the farmlands zones.

In this perspective; the two following priority entries should be considered, and designed/ implemented on strong methodological and scientific basis

Relationship between agriculture and the environment
The functioning of agro-ecosystems in rural areas (and in ecosystems more or less affected by human activities- gazetted forest, national parks…) is in jeopardy in the Aberdare like in many areas of the word. This is seen in the impact of agriculture production on ecosystem dynamics and vice-versa. Furthermore, the extension of agriculture creates strong pressure – and often conflicts- as regards environmental issues and recognition of environmental public goods. Hence, the challenge is to develop a land use engineering strategy based on both agricultural production and restoration of the ecological services rendered by ecosystems.

Ecological intensification
Agricultural systems should be designed to use ecological processes and functions for many purposes of which: more efficient use of scarce natural resources (such as water), enhancing ecological services (carbon sequestration, biodiversity, soil conservation and fertility maintenance, etc). This is the premise of ecological intensification; it involves managing living systems, recognizing and supporting their complexity and diversity, and using the broad range of interactions that regulate those systems. Agroforestry and conservation agriculture are ecological intensification based systems. Such agro ecosystems are locally commonly practised by the farmers of the Aberdare range; they should be strengthened here or promoted elsewhere, adjusted to site specific conditions and up scaled within the farmlands zone and the dedicated water catchment (for example the upper catchment of the Tana river, considering the importance of this catchment for Nairobi water supply and the farming systems in ASAL -Arid and Semi Arid Land- downstream).

8.1.2. Proposal

To design a pilot Project based on an integrated land use and watershed management approach, through well planned feasibility study which should notably include the following steps and specifications:

- selection of a water catchment, and sub-catchment where to concentrate the intervention (versus dispersal of actions, on too large area); it could purposely include a dam or be connected with dam issues (siltation, water quality, etc) allowing, later on, an appropriate monitoring and impact assessment ;
- delineate, and characterize the (sub-)catchment (bio-physical, socio-economic traits) with the view to design a pilot Project (through macro and micro diagnosis process, including assessment of watershed/catchment degradation issues, etc.)
- identify and discuss with the local communities and the groups and associations they constitute (TNG, CFA…) and local stakeholders within the delineated area, to ensure their involvement , sensitize and mobilize them; assess the conditions of adoption of

proposed technologies and innovations and sustainability of new practices (agroforestry, conservation agriculture, soil and water conservation techniques);
- design the pilot Project, with definition of the implementation framework, ex ante assessment of the potential Project impact, etc.
- discussion, restitution and adjustments through workshop.

The remaining one year period is an opportunity to prepare such a continuation with the current Project (and development of its approach, viz. more holistic); in any case, GBM has to answer the question: what could be next? In this perspective, and based on the main findings of the Project (success, bottlenecks, etc.), reflections and meetings could be initiated. A workshop on global land and watershed management (state of art, or lessons learnt, potentiality and perspectives) in Aberdare region, involving all stakeholders could be a first step to be organized by GBM, and support of concerned donors. The results of that workshop should give ground to set up a feasibility study.

8.2. Follow-up of tree plantations, up scaling

8.2.1. Rationale and objectives

Invested efforts and results obtained by the Project (nurseries, tree plantations, constitutions of groups, networking, etc) constitute a valuable experience to be pursued, consolidated and extended.

A minimal follow up of planted trees on forest sites as well as on various public sites should be managed with the view to improve knowledge on planted tree species and considering that indigenous and slow growing species will not become mature and have significant environmental impact before 10 to 20 years. As a matter of fact, most of the results obtained by the current Project in 3 to 4 years are preliminary.

Planting trees on farmlands with the double objective of production and diversification of its members livelihoods -to satisfy farmers' needs and cash with high value added products- and rehabilitation of the environment (soil and water conservation, N-fixation, etc), be promoted through agro forestry systems and practices, and the proposed integrated watershed management.
This will require the extend or strengthening of GBM support to farmers and nursery groups, in dedicated area (s), possibly integrating previous tree plantations of the Project and where farming systems will be designed in functional and sustainable agro-ecosystems

8.2.2. Proposals

Regarding the current plantations of the Project: trees will be measured every year (survival, growth), through appropriate (reduced) sampling applied to permanent micro-plots, within the planted blocks. Tree performance, ecological requirements, growth and potential environmental impacts could therefore be compared between species and sites on the long run, from juvenile stage to maturity. This follow up will give a solid ground for future indigenous tree plantations, their selection and management.

It will also give an excellent opportunity to assess and model environmental efficiency of trees, notably on water issues (consumption, release, etc), in relationship with soil, climate and other conditions (including fire and browsing). In this perspective, collaboration with the University and allied research centres like KEFRI and ICRAF should be looked for and studies be designed and proposed to post-graduate students.

On new tree plantations (agroforestry systems, woodlots and orchards), it is proposed to initiate a strategy that will equip the farmers with the best options for continuous profitable revenue generation through years –considering that "commercial" trees constitute the main driver when planting on farmlands, whereas rehabilitation of the environment is to be considered as a second (but essential complementary) objective.
This will require the integration of various scales of land use management, from agricultural landscape to farm and plot levels, selection of the right tree species ("best bet" in properly identified site specific conditions) and design tree "ideotype" (appropriate tree management practices for any selected species).

A second set of issues will be to deal with the market, access, organisation and linkages, so that farmers can optimise their revenues (wood and non wood products). It would also be necessary to come up with techniques for improving the quality of these products, such as timber, notably through simple market focused processing techniques to guarantee the producers with the best prices or added-value.

8.3. Income generating activities (IGA)

8.3.1 Design of integrative and innovative IGA

Project experience in IGA is modest as Tree Nursery Groups are just starting such activities which appear to be an excellent tool to bridge tree planting local economy, and a booster for livelihoods improvement.
On the basis of initiated activities and preliminary results, specific design for IGA promotion is to be thought about, in collaboration with local stakeholders (NGO, extension services, etc.). In this perspective, it is important to analyse in depth the conditions of development of IGA: status as of now (active/dormant, successes and failures) and as a whole constraints, needs, organizational aspects, levels of investments and returns – through survey and quantification of current IGA- with the view to define a strategy and the conditions of implementing a program (to be designed as a component of the proposed integrated watershed and land use management Project).

In line with the current GBM/AFD Project log frame, such a design should favour micro Projects that have an environmental conservation inclination (and have been little explored or developed during this Project) : biodiversity-bee keeping, insect rearing such as butterflies, herbal orchards/herbal gardens, etc, or high value products using water conservation technology e.g. green house tomatoes, drip irrigated vegetables, etc, or utilization and protection of the water source, e.g. fish keeping in the streams; or aquaculture in ponds fed by these streams, or high value with soil conservation, such as organic gardening, or promote understanding of nature and culture, e.g. ecotourism,etc. Most of these activities are integrative -combining (expected) economic returns and environmental conservation- and innovative, and therefore have to be programmed and tested with appropriate assistance (expertise).

8.3.2 Training in IGA

Training on how to start up and sustain such IGA is to be provided through ad hoc courses and support. Procedures and steps could be designed and formalized in the form of technical notes and pamphlets, taking into an account the technical, marketing and financial aspects. Communication is also an important aspect when looking for markets dealing with bulk quantities and best prices. All these aspects require expertise that GBM does not have, and specific market studies

8.3.3 Micro-credit system

Set up a micro-credit system to facilitate the funding and the development of local micro Projects while groups are waiting the payment of compensation, should take the form of collective actions. Seed capital -to be recovered through compensation- should be provided to groups and IGA Projects that promote or serve environmental conservation
Stakeholders support is to be sought and expertise is also to be hired

8.4. Replication to other water towers

8.4.1. Context

In its design, the basic Project methodology is simple and easily understandable by the targeted groups and allied stakeholders. The rationale and objectives of the Project are in good correspondence with the vision of the GOK regarding the priority rehabilitation of the water towers of Kenya –one of which is the Aberdare, the strategic plans of the national institutions in charge of the management of the natural resources (KFS for natural forests, and KWS for wildlife), and the growing concern and support of the donors and certain international agencies such as UNEP.

As the rehabilitation of the five main water towers of the country has taken a great national priority and international interest, it is therefore advisable to set up a Project that is in line with that and that is highly replicable from one tower water to the other water towers – without ignoring the specific local conditions, and notably the socio-ethnic and economic dimension of the different water towers.

8.4.2. Proposal

Of particular interest would be the Mau Forests Complex (MFC), the largest and most threatened water tower of Kenya. As the GOK has planned to evict the squatters soon, large areas of vacated land will require to be rehabilitated and reforested, while an integrated land use management plan would have to be properly designed and applied involving the local communities. GBM experience would properly fit in the challenge of restoring in a sustainable manner the Mau forest ecosystem in compliance with MFC Task Force recommendations and could significantly contribute to Mau complex rehabilitation -once the

on going highly volatile political debate and related social tension has calmed down,the job could start (the proposed multiple asset approach, which recognizes the wide variety of values of the ecosystem and diversifies revenue streams by capitalizing on most, if not all, of the ecosystem values, thereby maximizing both conservation and economic returns on the investment is well cross-cutting the proposed holistic approach for a future GBM Project –see Rehabilitation of the Mau Forest Ecosystem, GOK, Sept 2009).

Another option could be to extend the current operations to the large watershed areas lying between the Aberdare and the adjacent Mt Kenya, which corresponds to the Upper Tana River catchment, hence reunifying in one watershed two major water towers
This would be the easiest (and eventually cheapest) way of reproducing, grading and scaling up the Project activity, since one would work with similar if not same environments and communities, and could expeditiously apply results and lessons learned.

Appendix 1: Program of the mission (17/09/09 – 03/10/2009)

Date	Timing and Contents
Wednesday 16/09	20.20 pm: arrival Dominique Louppe, at Nairobi JKIA airport
Thursday 17/09	10.00 - 12.30: Meeting of consutants at GBM, to program the mission, discuss the methodology with Mercy Karunditu
	14.30 - 17.30 : Meeting of consutants at GBM, to program the mission, discuss the methodology and review GBM documents
Friday 18/09	09.00 - 12.00: Meeting at AFD, Royal Insurance Hse: Nyokabi Gitahi, M. Bord-Laurans, J.P. Marcelli
	15.00 - 1600 : Meeting at NHIF Building with Philip Olum, Chief Executive Officer, Water Resources Management Authority
	17.30 - 18.30 : Meeting at GBM with Daniel Muli
Saturday 19/09	9.00 - 12.00 : Visit the Nairobi Arboretum to familiarize with the tree species
	14.00 - 17.00 : Finalization of the mission programme and field trip programme; reading and analysis of GBM documentation
Sunday 20/09 (Field trip, Day 1)	**08.30 : Departure for the Aberdares NP** - 3 consultants and the Head of the GBM/AFD Project, Mercy Karunditu
	11.00 - 18.00: Tour of the Aberdares Nat. Park : entry through Nyeri (East), exit through Mutubio gate (West) - Naivasha
	19.00 : Arrival at Naivasha Country Club
Monday 21/09 (Field trip, Day 2)	**09.00 : Departure for Limuru constituency**
	11.00 - 13.00: Visit Tigoni, Ithanji, Manjiri and Tieikunu network, TNG and tree nurseries
	> met : Anne Githaiga, Extension Officer (EO), Wilfred G. Njoroge, Chief Tigoni location, Peter Ngetho Kaigua, Green Volunteer (GV)
	13.00 - 15.00: Visit forest sites in Kikuyu escarpment and Karera Ngubi > Upland Forest station, Tiekunu site
	> met Charles Karanja, GV
	15.00 - 17.00: Visit Matatu Operators Nursery Groups > met Peter Waititu, Chairman
	18.30 : Return to Naivasha

Tuesday 22/09	**09.00: Depart Naivasha for Lari constituency**
(Field trip, Day 3)	10.30 - 11.30: Meeting with S.K Adika, District Water and Irrigation Officer - Kiambu West District
	> met : Edward Muguheli, Lari EO, Geoffrey K. Njoroge, South Kinangop EO
	12.00 - 13.30: Visit Kwa Iregi Self Help Group in (Lower) Uplands Forest station
	15.30 - 17.00: Visit Nyamweru tree nursery, Uplands Forest
	17.30: Visit of Kamae Biocarbon site
	19.30: Return to Naivasha
Wednesday 23/09	**09.00: Depart Naivasha for North Kinangop Constituency**
(Field trip, Day 4)	10.30 - 12.00: Visit Hekaheka tree nursery/Nadaras network, and Kahuho primary School site
	> meet James Mwangi, EO North Kinangop, H/master - Charles Maina & Peter Kariuki - Env. Teacher
	13.00 - 13.45: Visit Ndunyu Ruthiu tree nursery, Mukungi sub-location
	15.00: Visit Mekaro Bee tree nursery, Mekaro sub-location
	16.45 - 18.00: Interview extension officers - Rueben Nduati (Kipipiri Constituency) and James Mwangi (North Kinangop Consituency)
	19.00: Back to Naivasha
Thursday 24/09	**09.00: Departure for Geta Forest and Kipipiri Constituency**
(Field trip, Day 5)	10.30 -12.00: Meet forester of Geta Forest Station - James Gichia, and Warden in charge of Aberdares Nat. Park - James Magina
	with James Mwangi Karori, EO N. Kinangop, and Rueben Nyoike Nduati, EO Kipipiri
	12.30 - 14.00: Visit Geta Compartment Site (Siambogo), meet with Green rangers - Jacob Macharia, Peter Ndirangu, Richard Komu
	14.30 -16.00: Visit Jembe tree Nursery
	16.00 - 17.00: Visit Kianugu tree nursery -

	17.00 - 18.00: Visit compartment 3 site
	19.00: Back to Naivasha
Friday 25/09 (Field trip, Day 6)	**08.30 : Departure for Kieni Forest and Gathundu North constituency**
	09.30 - 12.30: Compartment 3 site. Meet with J. Wanjiku (EO, Gatundu) ,members of Kieni Network - G.Nduati, P. Gaconde, P. Irungu
	16.00 - 17.30: Visit Marugano tree nurseries, Nguna sub-location, Gathundu North constituency
	18.30: Thika, arrive and lodge at Blue Post Hotel
Saturday 26/09 (Field trip, Day 7)	**9.00 : Departure for Kigumo constituency and Gatare Forest**
	9.30 - 11.00: Visit Gatare Forest/Githika forest block; interview with Ashiphord Kamau Ngigi, EO Kigumo
	> with Monica Wangari, EO Kiharu const., Christopher, EO Gitanga const., and Dioniso K. Ndegwa, Project Officer, Basque Gvt
	11.00 - 11-45: Visit Green Volunteers Self Help Group and Tree Nursery, Kagare location
	12.30 - 14.30: Visit Kangari dispensary public site
	14.30: Depart for Nairobi; arrival at 16.30
Sunday 27/09	10.00 -12.00 : Consultant exchanges and debriefing of the mission
Monday 28/09	9.00 : Debriefing (cont.) : sharing field notes, and data analysis
	14.00: Sharing field notes, and data analysis (cont.)
Tuesday 29/09	09:00 -10.00 : Meeting at GBM - D. Louppe, M. Kabengi and M. Karunditu
	11:00 - 12.30 : Meeting with Kenya Forest Service - Esau Omollo, Maurice Wanyiri, John M. Ngatia and Benedict Omondi
	14.00 - 18.00 : Data analysis and interpretation
Wednesday 30/09	08:00 Meeting at GBM - D. Louppe and Daniel Muli
	10:00 - 12.00 Meeting with US Agency for International Development - D. Depommier, Beatrice Wamalwa and Robert Buzzard
	11:00 - 12.30 Meeting with Kenya Wildlife Service - Judy Nyunja and Jacqueline Mutwiri, D. Louppe, M. Karunditu
	15:30 - 17.00 Meeting with World Bank - Senior Natural Resources Management Specialist - Ladisy Chengula

Thursday 1/10	09:00 - 11:00 : Meeting with GBM - D. Louppe, M.Kabengi, Wanjiru Nderitu , GBM monitoring and evaluation officer
	12:00 - 14.00 : Meeting of the consultants at CIRAD regional offices to discuss the preliminary draft report
	14.30 - 18.30 : writing up the preliminary draft report (cont.)
Friday 2/10	9.00 -14.30 : writing up the preliminary draft report and its presentation to GBM/AFD
	16.00 - 18.30 : presentation of the preliminary draft report to GBM/AFD at GBM Offices - Hughes Building, Nairobi
Saturday/ 3/10	9.00 - 11.00 : Debriefing of the presentation and exchanges held with GBM and AFD at Jacaranda hotel - D. Louppe and D. Depommier
	15.00 -16.00 : Framing up the final report, and compiling documentation, before dispersal of consultant team
	21.55 pm: departure of Dominique Louppe, from JKIA airport
Friday 23/10/09	15.00–18.00 Meeting with Prof. Wangari Maathai, GBM team and AFD – M. Bord Laurans and N. Gitahi.

Appendix 2: List of institutions and persons met during the AFD/GBM Project Review Mission

2.1 : In Nairobi

INSTITUTION		NAME	DESIGNATION	EMAIL	POSTAL ADDRESS	POSTAL CODE	TOWN	TEL
AFD	Agence Française de Développement	MARCELLI Jean-Pierre	Director	marcellij@afd.fr	P.O. Box 49475 –	00100 GPO	Nairobi	2711234/ 2718452/ 2718457 0733635300
AFD	Agence Française de Développement	BORD-LAURANS Mathilde	Chargée de mission	bord-lauransm@afd.fr	P.O. Box 49475	00100 GPO	Nairobi	2711234/ 2718452/ 2718457 0725785435
AFD	Agence Francais de Développement	GITAHI Nyokabi	Chargée de mission - environnement	gitahin@afd.fr	P.O. Box 49475	00100 GPO	Nairobi	2711234/ 2718452/ 2718457 0722241169
GBM	Green Belt Movement	MAATHAI Wangari	Founder & Board member GBM		P.O. Box 67545	00200	Nairobi	3871523/ 3873050
GBM	Green Belt Movement	MULI Daniel	Executive Director	dmuli@greenbeltmovement.org	P.O. Box 67545	00200	Nairobi	3871523/ 3873050 0722540714
GBM	Green Belt Movement	KARUNDITU Mercy	Project Officer	mkarunditu@greenbeltmovement.org	P.O. Box 67545	00200	Nairobi	3871523/ 3873050 0711347117
GBM	Green Belt Movement	NDUNDA Peter	GIS Officer	pndunda@greenbeltmovement.org	P.O. Box 67545	00200	Nairobi	3871523/ 3873050 0723946215
GBM	Green Belt Movement	KAGE Simon	Project Officer	skage@greenbeltmovement.org	P.O. Box 67545	00200	Nairobi	3871523/ 3873050
GBM	Green Belt Movement	NDERITU Wanjiru	Monitoring and Evaluation Officer	wnderitu@greenbeltmovement.org	P.O. Box 67545	00200	Nairobi	2220159 0733701461
KFS	Kenya Forest Service	WANYIRI Maurice	Biodiversity Officer	wanyirimaurice@yahoo.co.uk	P.O. Box 30513	00100 GPO	Nairobi	2020285 0734901386
KFS	Kenya Forest Service	OMONDI Benedict	Head of Watershed Management	bomondi@kenyaforestservice.org	P.O. Box 30513	00100 GPO	Nairobi	2020285 0722796950
KFS	Kenya Forest Service	NGATIA John M	Corporate Planning Officer	johnmngatia@yahoo.com	P.O. Box 30513	00100 GPO	Nairobi	2020285 0713562093
KWS	Kenya Wildlife Service	NYUNJA Judith	Senior Scientist for Wetlands	Jnyunja@kws.go.ke	P.O. Box 40241	00100 GPO	Nairobi	600800/ 602345 0726610508

KWS	Kenya Wildlife Service	MUTWIRI Jacqueline	Assistant Research Scientist - Ecological Monitoring	jackiemutwiri@yahoo.co.uk	P.O. Box 40241	00100 GPO	Nairobi	600800/ 602345 0726610508
USAID	United States Agency for International Development	WAMALWA Beatrice	Program Management Specialist	bwamalwa@usaid.gov	P.O. Box 629	00621, Village Market	Nairobi	8622680/8622681 8622250
USAID	United States Agency for International Development	BUZZARD Robert F. Jr.	General Development Officer	robuzzard@usaid.gov	P.O. Box 629	00621, Village Market	Nairobi	8622680/ 8622681 0722 335314
WB	World Bank	CHENGULA Ladisy	Senior Natural Resources Mgt Specialist	lchengula@worldbank.org	P.O. Box 30577	00100 GPO	Nairobi	3226416 3226400
WARMA	Water Resources Management Authority	OLUM Philip	Chief Executive Officer	olumphil@yahoo.com	P.O. Box 45250	00100 GPO	Nairobi	2732291 2729048

2.2: During the field trip

Name	Designation	Constituency
Christopher Wamugunda	Extension Officer	Gatanga
Gaconde P.	Kieni Network member	Gatundu North
Irungu P.	Kieni Network member	Gatundu North
Nduati G.	Kieni Network member	Gatundu North
Wanjiku Jane Olive	Extension Officer	Gatundu North
Pretty Joy Karwitha		Gatundu South
David Kimani Muturi	Green Volunteer	Githunguri
Samuel Gathu Mbugua		Kangema
Ndegwa Dioniso K.	Project Officer, Basque Green Volunteers	Kigumo
Ngigi Ashiphord Kamau	Extension Officer	Kigumo
Wangari Monicah	Extension Officer	Kiharu
Gichia James	Forester - Geta Forest Station	Kipipiri
Komu Richard	Green ranger	Kipipiri
Macharia Jacob	Green ranger	Kipipiri
Ndirangu Peter	Green ranger	Kipipiri
Nduati Rueben	Extension Officer	Kipipiri
Adika S.K.	District Water & Irrigation Officer - Kiambu West	Lari
Muguheli Edward	Extension Officer	Lari
Githaiga Ann	Extension Officer	Limuru
Kaigua Peter Ngetho	Green Volunteer	Limuru
Karanja Charles	Green Volunteer	Limuru
Njoroge Wilfred G	Chief - Tigoni Location	Limuru
Waititu Peter	Chairman - Matatu Operators	Limuru
Joseph Kimani Karanja		Mathioya
Kariuki Peter	Environment Teacher - Kahuho Primary Sch	North Kinangop
Karori James Mwangi	Extension Officer	North Kinangop
Maina Charles	Headmaster - Kahuho Primary Sch.	North Kinangop
Geofrey Kungu Njoroge	Extension Officer	South Kinangop
Josephine Wangari	Office Based Facilitator	
Asuntah Muchomba	Office Based Facilitator	

Appendix 3: Terms of Reference

Green Belt Movement – Aberdare Reforestation Project 2006-2009

Mid-Term Review

A Project implemented by the Green Belt Movement (GBM) and supported by AFD

TERMS OF REFERENCE

1. Background

The majority of Kenya's forests are gazetted as forest reserves. At the turn of the 20th century Kenya had an estimated 30% natural forest cover and many rivers crisscrossed the mountains and the countryside. Today, Kenya's gazetted forest resources cover a total of 1.24 million ha, consisting of indigenous and plantation forests, which is 1.7% of the country's land area. It is largely confined to the semi-humid and humid parts of the country and are largely mountaneous forests occuring at altitudes of up to 3,000 metres in two main regions, namely:

- The Western Rainforest Region, which has nearly 19,000 ha of forest and includes the Kakamega and Nandi forests. This is a remanence of the East African Equatorial Forest, characterised by a diversity of hardwood species and an average rainfall of about 1,600 mm per annum.
- The Mountain Forest Region in the central highlands, which has 748,500 ha of indigenous forest and 102,800 ha of plantation. Included in the Mountain Forest Region are Mt Kenya forests, the Mau forests and the Aberdares/Kikuyu escarpment. They represent an overwhelming portion (over 90%) of Kenya's gazetted forests.

The forest areas are important water catchment areas for the country's most important rivers. The mountain forests are also of major importance for biodiversity, wildlife, hydrology and wood production. The forests also provide wider environmental benefits including serving as carbon sinks. They protect catchments that supply water for rural and urban populations, for irrigation and power generation. The Mount Kenya and Aberdare forests are especially important in this respect, as they are the main catchment areas for the River Tana, from which most of Kenya's hydropower is generated. Nairobi, with a population of about 3 million depends entirely on the Aberdares for its drinking water.

The current threats on the Aberdare forest ecosystem include forest fires, illegal logging of indigenous tree species, illegal grazing, illegal charcoal production, illegal cultivation of crops and settlement. This has adversely affected the ecosystem hydrological functions as well as local biodiversity.

Forest management in Kenya

Forest reserves on government land and include the majority of large, closed-canopy forest blocks such as the Aberdare Range, Mt. Elgon and the Mau complex, as well as the forest plantations. The management of gazetted forest reserves is vested in the Kenya Forest Service and every forest has a management plan.

There are also closed-canopy forests gazetted as national parks and national reserves managed by KWS (Aberdare National Park). Some gazetted forest reserves of high biodiversity significance are managed by Kenya Forest Service and KWS through a Memorandum of Understanding, such as the Aberdare Forest Reserve.

An estimated 100,000 hectares of forest are classified as trust land and are vested in the respective local authorities under the Ministry of Local Government. There are also indigenous forest areas under private ownership, either as units held individually or within Group Ranches. Many of these usually small holdings are important for catchment and streamline conservation.

Aberdare forest Ecosystem

The area of the Aberdare forest ecosystem is around 208,000 ha, shared between the Aberdare forest reserve (99,170 ha), the Kikuyu Escarpment forest reserve (37,619 ha) the Kipipiri forest reserve (4,413 ha) and the National park (76,700 ha), which is mainly covered by moorlands. Five main ecosystem types are present in all gazetted forests :

- Indigenous natural forest : 51,972 ha 36%
- Plantations of exotic trees : 24,125 ha 17%
- Bamboo : 45,970 ha 33%
- Bushland : 11,073 ha 8%
- Grassland : 8,062 ha 6%

The largest part of the gazetted forest and the National Park are inside the Rhino Ark fence, with a long term objective to remove the current exotic plantations and rehabilitate natural forests. Outside the fence, the main goal is generally commercial plantations.

Overview of GBM

GBM, a Kenyan Non-Government Organization (NGO), initiated the Project, which was implemented through its network of community tree nursery groups throughout the Project area.

The Green Belt Movement is a grassroots non-governmental organization that has worked in environmental conservation and community development in Kenya for 31 years. Founded in 1977 by Prof. Wangari Maathai, the winner of the 2004 Nobel Prize for Peace, GBM has used tree planting as an entry point to community development in 7 provinces in Kenya (Nairobi, Rift valley, Western, Nyanza, Central, Eastern and Coast). The organization's vision is to create a society of people who consciously work for continued improvement of their environment and a greener, cleaner country. While tree planting has always been the focal activity, GBM programs have expanded to include Projects in tree planting, civic environmental education, networking and advocacy, food security, water harvesting,

greenbelt eco-safaris, Income generating activities, empowerment/capacity building, and GIS facility for mapping among other things. Through these Projects GBM promotes environmental consciousness, volunteerism, conservation of local biodiversity, self-empowerment, community development and accountability and peace. The current partners of the GBM are the Restore UK, the French Development Agency (AFD), USAID, Spanish UNEP, Comic Relief (UK), Basque, Telenor, Heinrich Boell Foundation, African UNION (ECOSOCC), Angel Network, Shaklee Corporation, KPMG, AMREF, KEIDANREN, AEON Foundation, Moittainai, Green Forum, Barraket and NOVO Fund.

For thirty one years, Prof. Maathai and the GBM have demonstrated their unfailing commitment to the environment and to communities taking a lead role in the sustainable management of natural resources. The capacity of GBM is attested, with a result of 42 millions trees planted in the farmer's private and public lands and forest sites with the communities.

GBM clearly demonstrates its ability to hire qualified and experienced people for that. Now they already have a number of young and enthusiastic foresters, with 5 Masters in Science and 62 Bachelors in Science (Forestry, Natural resource management, Environmental sciences and Agriculture) with good skills and experiences in community forest management. In addition, the Green Belt Movement's 31 years of experience, is a testimony of its flexibility. The professional capacity of the organization has increased dramatically since funds accrued after the Nobel Peace Prize. Under the present leadership, the Green Belt Movement has recently recruited Director Finance and Administration and a Programme officer (PhD) and the institution will be able to develop still more capacity. GBM has a GIS facility for GBM Projects Database development and maintenance for the purposes of planning, monitoring and evaluation.

The Proposed Project Area

The Project was to focus on a core area in the west and the south of Aberdares, in the constituencies of Kinangop (Nyandarua district), Lari (Kiambu district), Gatanga (Thika district) and Kigumo (Maragua district). In case of GBM additional funding from other donors, the Project will be extended to an additional area in the rest of constituencies touching the Aberdares forest. The Project area includes the major part of the watersheds which ensure the water supply of Nairobi (Sasumua reservoir, Ruiru reservoir and Mwaghu and Ngethu intakes).

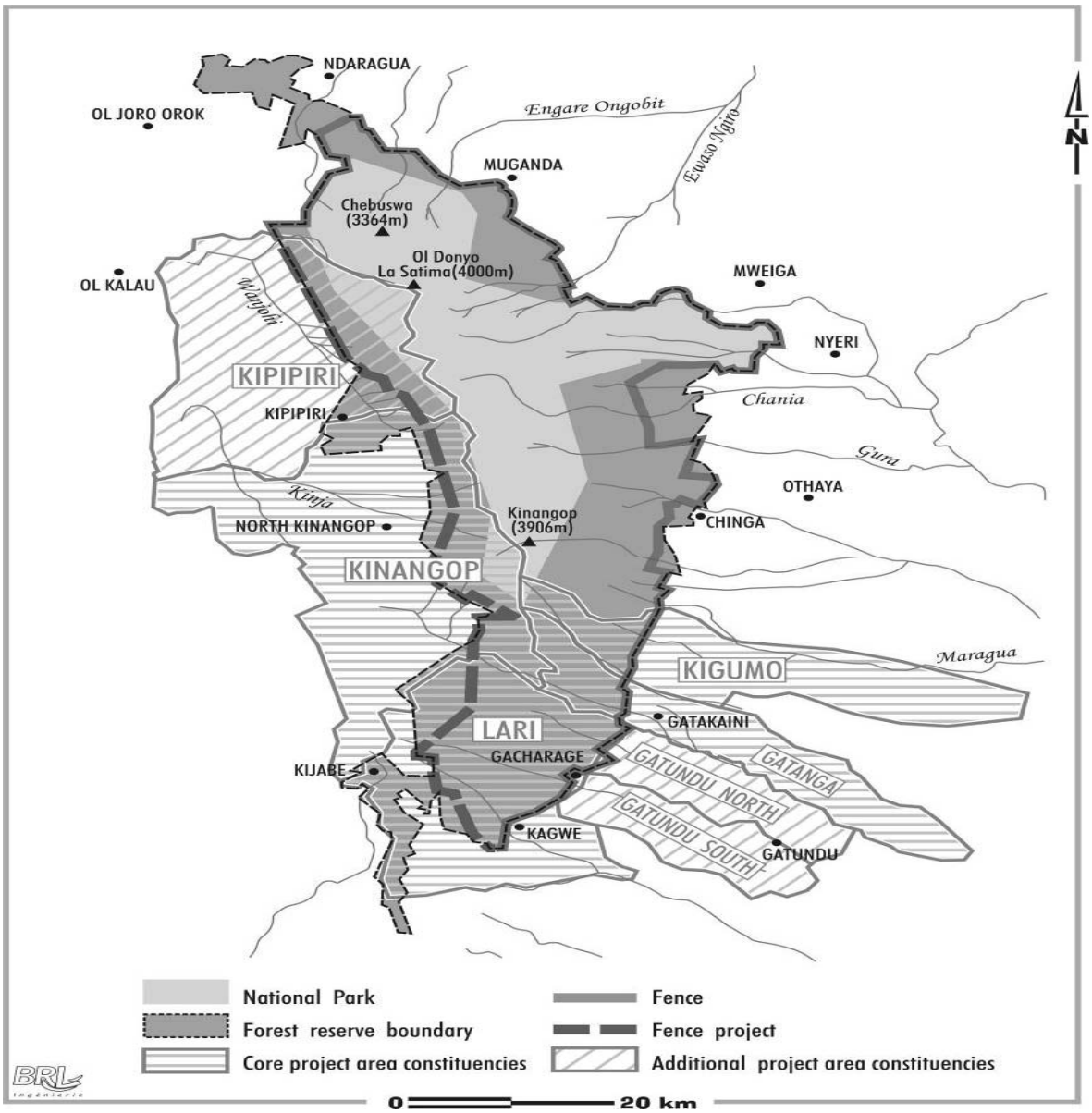


Figure 1: Map of the proposed Project area

2. The Project

Project Objectives

The overall goal of this Project is to restore the degraded areas of the Aberdare forest ecosystem to improve its functions (Mainly water and biodiversity conservation) and improve the livelihood of the local communities adjacent to the ecosystem.

In order to achieve this broad objective several specific objectives were developed, these include;

I. To rehabilitate degraded forest areas by replanting local species, this will continue to maintain hydrology, the soil and the biodiversity of the forest.

II. To support and diversify, in a sustainable manner, the sources of income of the neighbouring populations of the forest by generating income from indigenous forest plantation activities and promoting an alternative and profitable use of the forest.
III. To promote protection initiatives for the forest by the civil society (NGOs and women groups).
IV. To create conditions for replication of a pilot Project for total rehabilitation of the forest basin slope.

The Agence Française de Développement (AFD, or French Development Agency) is a public institution providing development financing. As specialized financial institution, AFD finances sustainable development Projects with primacy given to Africa which receives two-thirds of AFD commitments. These Projects focus on urban development and infrastructures, rural development, industry, financial systems, and education and health.

The AFD Aberdare Project has been ongoing for the past two and half years. The objective was to plant 2000Ha of degraded forestland with indigenous trees. The Project area was later expanded to cater for Ndaka-ini and Sasumua dams that are critical to continuous supply of water to Nairobi city and its environs and to provide more forest areas to have 2000 Ha. To achieve this objective, 12 extension officers were posted to the constituencies falling within the Project area in 2006. This has had a tremendous impact in terms of mobilization, recruitment, training of grassroots communities that are responsible for raising and planting of seedlings.

To date the Project has 526 tree nurseries in 97 networks/sub-locations. A total of 1,353,072 trees were planted and validated as surviving in forest and public lands for 2006. The tree nursery groups that had planted the trees were compensated a total of KSh 6,464,301 in 2007. In 2007 the communities planted 1,748,838 in the forest and public places. Validation for these trees and mapping of planted sites is ongoing and compensation will follow immediately. In 2008 the 464,521 trees were planted and in total the Project has planted 3,566,421 trees to date. Out of this, 1,808,307 trees have been planted in forest land (1,800 Ha) and 1,761,114 trees in public places (on farms, schools, church compounds, road and river reserves (1,700 Ha). Thus, the Project has planted 3000 Ha in Aberdares forest ecosystem and areas adjacent to ecosystem.

Notable benefits from this Project especially to grassroots communities include; improved incomes from trees validated as surviving and compensated. Other future benefits include; provision of clean drinking water to the local communities, reduced green house gas emissions (BioCarbon sites) and conservation of local biodiversity. The success of this Project is anchored on effective collaboration between the community, GBM, AFD, KFS, KEFRI and KWS.

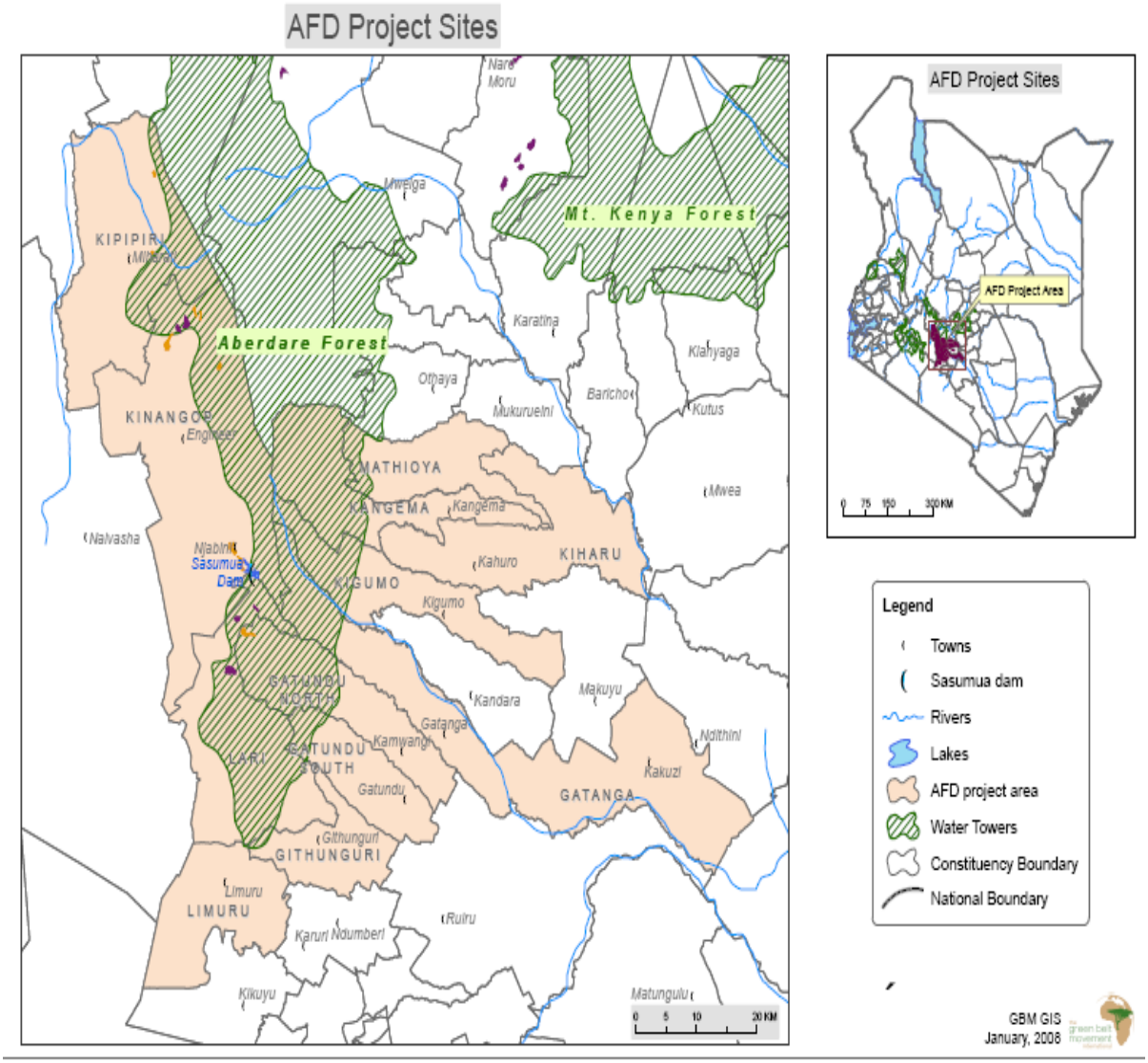


Figure2: Map showing constituencies falling under AFD Project area

Activities and Results

Table 1: Various meetings held by communities, included are the constituency names, date, the number of people who attended and agenda in 2006.

Constituency	Date	People attending	Agenda of meeting
Kigumo	24-25/10/06	100	Community participation in forest management
Gatundu North	2/11/06	10	Survey of Kieni forest destruction by Kamunyaka network members and GBM headquarter staff
Limuru	28/10/06	48	Cleanup exercise
Lari	30/1/06	68	Stakeholders and community mobilization to address issues affecting tree planting in the forests
Total		**226**	

Table 2. Various meetings held by communities, included are the constituency names, date, the number of people who attended and agenda in 2007.

Constituency	Date	People attending	Agenda of meeting
Kiharu	29/06/2007	61	Plan and organize for validation
Gatanga	17-18 /5/ 2007	97	Civic Environmental Education
Gatanga	15-16 /5/2007	96	Civic Environmental Education
Gatanga	21-22/6/07	104	6 networks training in GBM procedures and tree nursery establishment and management
Gatanga	20/06/2007	49	Community Forest Association meeting
Gatanga	17-18/5/07	100	Community participation in forest management
Gatanga A	15-16/5/ 2007	95	Community Forest Association
Gatanga B	17-18/5/ 2007	97	Community Forest Association
Gatundu north	21/02/2007	142	Outreach seminar
Githunguri	28/2-2/3/ 2007	105	Civic Environmental Education
Kigumo	26-27/6/07	100	GBM ten steps
Kipipiri	01/03/2007	80	Seedling planting and security
Lari	12/06/2007	28	Field visit by Muiri group
Lari	30/01/2007	67	GBM meeting in Kinale forest
Limuru	28-30 /3/ 2007	100	Civic Environmental Education
Limuru	18-19/6/07	114	GBM procedures
Limuru	13-14/6/07	100	Community participation in forest management
Limuru	26/02/2007	102	Outreach seminar
Limuru	14/02/2007	116	Outreach seminar
Limuru	08/12/2007	36	Network leaders
Mathioya	04/06/2007	33	CFA follow up meeting to discuss management plan
Mathioya	27-28/3/07	160	Community participation in forest management
Mathioya	21/02/2007	30	Consultative meeting (GVs and committee officials)
Mathioya	11/12/2007	54	Modalities of reporting
N Kinangop	11/12/2007	81	Proposals for specific management plans
N Kinangop	03/12/2007	81	Consultative meeting with group officials
S Kinangop	23-24/6/07	103	Community participation in forest management
S Kinangop	23-24/5/ 2007	96	Civic Environmental Education
S Kinangop	11-13/4/2007	106	Community Forest Association
S Kinangop	23-24/5/ 2007	96	Community Forest Association
Total		**2629**	

Table 3: Tree planting in the first and second semester of 2007

	Tree planting 2007			**1st semester**			**2nd semester**		
Constituency	**Tree planting in Public lands**	**Tree planting in Forest sites**	**Total trees planted**	**Tree planting Public lands**	**Tree planting Forest sites**	**Total trees planted**	**Tree planting Public lands**	**Tree planting Forest sites**	**Total trees planted**
Gatanga	154,050	7,300	161,350	58,951	6,200	65,151	95,099	1,100	96,199
Gatundu South	65,621	75,695	141,316	1,900	30,000	31,900	63,721	45,695	109,416
Gatundu North	97,221	104,867	202,088	217	33,640	33,857	97,004	71,227	168,231
Githunguri	4,174		4,174	2,909		2,909	1,265		1,265
Kangema	22,975		22,975	18,140		18,140	4,835		4,835
Kigumo	45,480	161,238	206,718	29,260	127,168	156,428	16,220	34,070	50,290
Kiharu	212,221		212,221	86,000		86,000	126,221	0	126,221
Kipipiri	63,821	44,170	107,991	50,987	30,591	81,578	12,834	13,579	26,413
Lari	36,706	162,500	199,206	8,360	118,000	126,360	28,346	44,500	72,846
Limuru	13,250	80,100	93,350	9,450	43,700	53,150	3,800	36,400	40,200
Mathioya	89,694	47,895	137,589	67,252	25,145	92,397	22,442	22,750	45,192
North Kinangop	58,200	175,840	234,040		75,600	75,600	58,200	100,240	158,440
South Kinangop	1,860	23,960	25,820	1860	5,000	6,860	0	18,960	18,960
Total	**865,273**	**883,565**	**1,748,838**	**335,286**	**495,044**	**830,330**	**529,987**	**388,521**	**918,508**

Table 4: Trees planted per constituency, included is trees planted in public lands and forests and the percentage survival in each area (2006)

	Public sites			**Forests**		
Constituency	**Trees planted**	**Trees surviving**	**%survival**	**Trees planted**	**Trees surviving**	**%survival**
Gatanga	70,750	37,686	53.3	[a]		
Kangema	19,785	11,652	58.9	[b]		
Githunguri	5,314	3,328	62.6	[b]		
Mathioya	135,467	105,740	78.1	[a]		
Kiharu	385,919	313,044	81.1	[b]		
Kipipiri	46,648	27,967	60.0	16,500	5,010	30.4
Kigumo	90,072	45,918	51.0	83,828	71,426	85.2
Gatundu South	48,640	16,033	33.0	53,398	37,567	70.4
Gatundu North	100,890	77,890	77.2	93,902	72,452	77.2
Limuru	61,269	56,414	92.1	358,730	114,810	32.0
South Kinangop	21,040	6,460	30.7	35,415	19,390	54.8
North Kinangop	31,900	22,007	69.0	68,650	54,031	78.7
Lari	76,341	40,785	53.4	228,552	213,462	93.4

[a] *Trees have not yet been validated in these sites*

[b] *No trees were planted in gazetted forests*

Conclusions and implications

- A total of 1800 Ha have been planted in the forest and 1700 Ha in the public places (schools, church compounds, road and river reserves) with local tree species by women groups. Once these trees survive we expect a gradual increase in tree cover in

the rehabilitated areas which would have a positive impact on water volume and biodiversity.

- Promotion of protection initiatives for the forest by civil society has been done through civic and environmental education to the public. As a result the community understand and appreciate the need to protect forests both as a source of livelihoods and also for provision of water.
- Since inception of this Project many partners and stakeholders have come on board therefore there has been increased collaboration, experience gaining and sharing. The combined efforts of the various parties have been responsible for the Project achievements so far. In addition, this will enable a replication of this Project for a total rehabilitation of the forest basin.
- The communities in the Project area have become economically empowered from income received for compensation of trees planted and surviving (Ksh 6,464,301). This was a major contribution to the disposable income in the hands of women which has supported school fees, clothing, food and other domestic needs.
- Rain water runoffs, flooding and soil erosion will reduce in the longer term therefore safeguarding the livelihoods of many Kenyans downstream.
- The community capacity to manage and conserve their resources such as water, soils and biodiversity has improved. This has been indicated by the number of households involved in on-farm agro-forestry, on-farm soil and water conservation.
- The potting bags issued to tree nurseries through this Project will continue to benefit the local communities for many years since these are normally recycled.
- Techniques and skills initiated for better land-use management improve households' income for many years. Such skills like sack gardens, bee keeping, composting, simple food processing, water harvesting and terracing for participating farmers have multiple benefits.
- Documentation of the Project's milestones helps to share experiences at local, regional and international levels.

Nonetheless, for the objectives set out to be achieved there is need for efficiency in GBM system especially in regards to payment of trees. This is strongly attached to data collection, accuracy in entry, monitoring and evaluation by GBM GIS facility. In addition the socio-economic, hydrological and biodiversity survey will have to be carried out as soon as possible since this will enable comparisons to be drawn in future. This will be useful in measuring the Project success in as far as economic empowerment, impact on hydrology of the area and biodiversity conservation is concerned. Also the issue of after care of seedlings planted needs has been discussed and the best option has been taken in order to ensure that maintenance of the trees planted goes beyond the first year after planting.

AFD staff members both in the field and those based in GBM head office

	CONSTITUENCY	EXTENSION OFFICER
1.	Project Officer	Mercy Karunditu
2.	Githunguri	
3.	Gatundu South	Pretty Joy Karwitha
4.	Lari	Edward Muguheli
5.	Mathioya	Ashiphord Kamau Ngigi
6.	Gatundu South	Olive Wanjiku
7.	Kangema	Samuel Gathu Mbugua
8.	Kipipiri,	Reuben Nduati
9.	South Kinagop	Geofrey Kungu
10.	North Kinangop	James Mwangi Karori
11.	Kiharu	Monica Wangari
12.	Gatanga	Christopher Muchiri
13	Kigumo	Ashiphord Kamau Ngigi
14.	Limuru	Ann Githaiga
15.	Project facilitator based in Headquarter	Josephine Wangari
16.	Project facilitator based in Headquarter	Asunta Chomba

Networks

A network is formed at sub-location level and is a representation of all GBM tree nurseries within the sub-location. A network draws two members from each tree nursery group. It has a Chairperson, Secretary and Treasurer. A Green Volunteer (GV) is elected in each network and is responsible for compiling tree nurseries data on monthly basis.

Community Forest Associations

In order to expand sources of income for our groups we supported and guided them to form viable community forest associations for forest resources protection and utilization. The newly formed CFAs were assisted in developing strategic plans in line with the Project objectives and forest resources management in collaboration with Kenya Forest Service (KFS). A Community Forest Association (CFA) is an entity formed by members of a community in order to participate in the conservation and management of a state forest or local authority forest. The new forest act stipulates that the association shall protect, conserve and manage such forests; formulate and implement forest programmes consistent with the traditional forest user rights of the community concerned in accordance with sustainable use criteria; and do any other act that is necessary for the efficient conservation and management

of the forest. The association will benefit from the user rights conferred. These rights include collection of medicinal herbs, harvesting of honey, and collection of forest produce for community based industries, development of community non-wood forest based industries, among others. CFAs are a new provision under the newly enacted Forest Act (2005) which, in contrast to the previous Forest Act, provides opportunities for community participation in forest management.

CHALLENGES AND RECOMMENDATIONS

- Damage of trees planted by livestock - in order to overcome this fencing was done in some sites. In addition KFS has been patrolling some of these areas. GBM has also recruited green rangers in one site (Kamae forest) to act as a pilot of which this will be replicated in other sites upon success
- 

Figure 3: Domestic Animals freely grazing in the degraded gazetted forest sites

- Choking by weed- to overcome this manual spot weeding was done in all sites
- Inadequate means of transporting seedlings to planting sites- to overcome this various stakeholders such as KFS and the Kenya Army have been approached.
- Water shortage for some nurseries- to overcome this GBM liaised with KFS so that we could use their water supply.
- Poor survival of some of the recommended species for planting e.g. *Prunus Africana.* Consultations are being made with KEFRI on how best to deal with this problem. We are also promoting *Prunus solitina*

3. Objectives of the Review

The main objective of this review is to formulate an independent and reasoned opinion on the Project, to assess its progress towards its stated goals, and to identify constraints hindering such progress. The review process should also include recommendations for the remaining Project implementation period.

4. Approach & Methodology

The consultant will collect and review all the Project information and documents such as the Project feasibility study (see attached), the Project legal agreement, the Project progress reports, the audit reports, the AFD supervision reports, the extension officer monthly reports to GBM HQs, etc.These will be available from AFD and from the GBM.

The review process will also include interviews and consultations in Nairobi and in the field with the GBM, the women's groups, AFD (Nairobi office and HQs), the Kenya Forest Service, the Kenya Wildlife Service, the Kenya Forest Research Institute, USAID and World Bank who are also working with the GBM in the Aberdare, and other stakeholders of the Project. **The consultant will work independently** with these stakeholders. He/she may be or not accompanied by a representative of the GBM, as his/her conduct of the review requires.

In addition to interviews and document review, the consultant will carry out random checks in the field in reforested plots and tree nurseries selected by him/her.

5. Scope of the Review

- The review will focus on the following aspects of the Project although the consultant may come up with additional relevant issues:

a) Assessment of the implementation of the Project

- Review the activities that have taken place and the resulting outputs to date,

- Measure the performance, qualitatively and quantitatively, of the Project to date with respect to stated goals and objectives as defined in the Project document (the feasibility study) and the financing agreement by identifying specific accomplishments and/or failures,

- Assess the scientific methodology of the Project (choice of plots, choice of tree species, maintenance activities, etc.),

- Assess the socio-economic methodology of the Project (mobilisation of communities, compensations, tree planting, etc.),

- Assess the Project set-up and organisation (team, procedures, organisation local/HQ, internal controls, financial management, procurement) at GBM and make recommendations for changes if applicable,

- Assess the compliance of the Project implementation with all aspects of the financing agreement,

- Assess the quality and timeliness of the reporting (both internal and to AFD), make recommendations for revision,

- Review the biological and socio-economic monitoring system and impact indicators of the Project,

- Analyze the involvement of all stakeholders in the Project, their "buy-in" and perception of the Project. A focus on the neighboring populations would be important,

- Review the use of external expertise in the Project implementation and recommend on specific uses if applicable in the future,

- Identify efforts by other agencies contributing to the same goals in the same area and coordination between the AFD-funded Project and their Projects,
- Analyse the changes in context since the Project started, at the national and local level and within the Project implementation agency (GBM),

- Assess the way the GBM Project fits into the national forest management policy and the programs carried out by other stakeholders in the Aberdare. Assess the pertinence of the coordination mechanisms, among which the Steering Committee, with these other initiatives and policies.

b) Recommendations until the end of the Project (2009)

- Outline the lessons learned from experience to date and provide recommendations that can be used in the continuation or reorientation of the Project. These recommendations may go as far as to propose a complete reorientation of the Project, or cancellation of certain components and addition of others,

- Suggest aspects to be considered in the revision of the Project activities,

- Suggest aspects to be revised in the Project implementation set-up within the GBM,

- Suggest priority actions for the remaining 18 months.

c) Recommendations for after the end of the Project (after 2009)

- In the light of the findings of the evaluation, make recommendations for after the end of the current Project. Define broadly the nature of future interventions in terms of Project focus, components, geographical area, target groups and implementation strategy.

6. Time Frame

- To be suggested by the Consultant.

The review should include a 15 working-day mission to Kenya, of which at least 7 (and preferably more) in the Aberdare. The consultant will then spend 10 days for preparation and report writing, which gives a total of 25 days for the whole consultancy excluding travel days. A draft report should be circulated two weeks after the field work. AFD and the GBM will have two weeks to comment. The consultants will have two weeks to incorporate these comments and send a final version to the GBM and to AFD. An annex report with a specific

set of remarks and recommendations will be prepared for AFD if deemed necessary by the consultant. This annex report would remain the exclusive property of AFD.

7. Review Team

The evaluation is to be carried out by one international expert who may be associated with a national expert. The international consultant should have a background in tropical forestry or related field and have a good knowledge in social sciences. He/she should have experience in Project evaluation and participatory forestry Projects. He/she should be fluent in English.

A short list of international consulting firms has been identified. The consulting firms will be invited to provide the GBM with a proposal stating its experience in the field and in Africa, the suggested methodology, and a technical and financial proposal (in two separate envelopes).

8. Deliverables and Reporting Requirements

The consultants will be responsible for undertaking separate consultations as appropriate and for producing the evaluation report.

The consultants will write all documents in English.

Appendix 4: Documents consulted

1. GBM-AFD documents

1.1. Annual reports and studies

AFD/BRL, 2006: *Feasibility study for rehabilitation of the Aberdare Forest Ecosystem*, Nairobi 44 p.

AFD-GBM, 2006: *Half Year report. Rehabilitation of the Aberdare Forest Ecosystem*, July-Dec 2007, 6p.

AFD-GBM, 2007: *Annual report. Tree planting in Aberdares Forest Ecosystem*, Jan-Dec 2007, 25p.

AFD-GBM, 2007: *Half Year report. Rehabilitation of the Aberdare Forest Ecosystem*, Jan-June 2007, 17p.

AFD-GBM, 2008: *Half Year report. Tree planting in Aberdares Forest Ecosystem*, Jan-June 2008, 38p.

AFD-GBM, 2008: *Annual report. Tree planting in Aberdares Forest Ecosystem*, Jan-Dec 2008, 43p.

AFD/Nyokabi Gitahi, 2009: *Rehabilitation of the Aberdare Forest Watershed, Green Belt Movement (Aide-Memoire*), Kenya-CKE 6008, 13p.

AFD/GBM, 2006: *Site Selection Report, Aberdares for Bio-carbon & AFD Watershed Project to be implemented by the Green Belt Movement,* Revised Report, 20p.

AFD/GBM, 2009: GBM/AFD *Aberdare rehabilitation Project Baseline Report by Kenvirons Company Ltd*, Nairobi, 117p

CIRAD, 2009: *Aberdare Reforestation Project 2006-2009,* a Project implemented by the Green Belt Movement (GBM) and supported by AFD, *Technical Proposal*, *Mid-Term Review*, 54 p.

GBM 2009: *Community-based Resource Management, Eastern Aberdares Program*, Semi-Annual Progress Report, Niaorbi, 22p

GBM/Aberdares Reforestation Project 2006-2009, 2008**:** A Project implemented by the Green Belt Movement (GBM) and supported by AFD, *Mid-Term Review, Terms of Reference*, 14 p.

GBM/**Aberdares Reforestation Project 2006-2009,** 2008 A Project implemented by the Green Belt Movement (GBM) and supported by AFD, *Maintenance Strategic* Plan, 8 p.

GBM/**Aberdares Reforestation Project 2006-2009,** 2006: A Project implemented by the Green Belt Movement (GBM) and supported by AFD, *Biodiversity and Hydrological study*, 10p.

GBM/GBM, 2008*: Reforestation Bio-carbon* Project, 10p

GBM/ Forest Department, 2006: *Site selection report Aberdares for Bio-carbon & AFD Watershed Project to be implemented by the Green Belt Movement*, Nairobi.

GBM, 2009: Rehabilitation of the Aberdare Natural Forest Ecosystem Project, *Implementation Manual and rules of procedures*, revised 12th February 2009, version 2006(2)14p

Githaiga J., 2009**:** *Baseline data generation on biodiversity and hydrology in target areas of the Green Belt Movement* – Aberdares Reforestation Project 2006-2009, 24 p.

1.2. Field visits and Supervision missions

AFD, 2007: *Supervision mission report for Project CKE 6008*, 15th-25th October 2007.

AFD/Bord-Laurans M., 2008: Kenya-CKE 6008. *Rehabilitation of the Aberdare Forest Watershed, Green Belt Movement*, AFD/USAID joint supervision mission, 7p.

GBM/Aberdares Reforestation Project 2006-2009: *AFD-GBM Project steering committee field visit report,* April 3rd, 2008, 14 p.

GBM, 2009: *A GBM Aberdares Ecosystem Tour with Prof. Wangari Maathai and Diplomats*, report, 15th May 2009, 15p.

1.3. Work plans budgets, and financial statements

AFD/GBM, 2006: *Kenya-CKE 6008 01M*, *Financing Agreement,* Nairobi, 13p.

AFD/GBM, 2006: *Financial Statements*, *31 December 2006*, Kang'ethe & Associates, 12p.

AFD/GBM, 2007: *Financial Statements, 31 December 2007*, Kang'ethe & Associates, 12p.

AFD/GBM, 2008: *Financial Statements, 31 December 2008*, Kang'ethe & Associates12 p.

GBM, 2006: *Financial and Operational Guidelines*, 9p

GBM, 2006: *Half year budget and detailed schedule of activities,* 3p

GBM, 2007: *Work plan and Budget* 3p

GBM, 2008: *Work plan and Budget* 3p

GBM, 2009: *Work plan and Budget* 4p

1.4. Minutes of AFD/GBM meetings

AFD/GBM, 2007: *Minutes of the AFD-GBM meeting held on 28th March 2007,* Nairobi

AFD/GBM, 2007: *Minutes of the AFD-GBM meeting held on 25th May 2007,* Nairobi

AFD/GBM, 2008: *Minutes of the AFD-GBM meeting held on 03rd December 2008,* Nairobi

AFD/GBM, 2009: *Minutes of the AFD-GBM meeting held on 6th February 2009,* Nairobi

AFD/GBM, 2009: *Minutes of the AFD-GBM meeting held on 23rd April 2009,* Nairobi

AFD/GBM, 2009: *Minutes of the AFD-GBM meeting held on 2nd May 2009,* Nairobi

2. Forest tree and agro-forestry species

Beentje H. J, 1994: *Kenya Trees, Shrubs and Lianas***,** National Museums of Kenya, 722p.
ICRAF: *Agroforestry Data Base* http://intranet:8090/Sites/TreeDBS/Treedatabases.asp

Danida Forest Seed Centre: *Seed leaflets* (notes on various tree species), http://en.sl.life.ku.dk/Forkshing/Development

FAO, 2009: *Eucalyptus in East Africa, the Socio-economic and Environmental Issues*, FAO sub-regional office, Addis Ababa, March 2009, 40 p.

ICRAF 1992: *A selection of useful trees and shrubs for Kenya*, Notes in their identification, propagation and management for use by agricultural and pastoral communities, 225p.

KEFRI, 2008: *Revised Seed Catalogue*, Kenya Forestry Seed Centre, Oct. 2008. http://www.kefri.org

Kindt R. *et al,* 2002: *Trees Seed Suppliers Directory*, Sources of seeds and microsymbionts, ICRAF, Nairobi 426 p.

Kindt R. *et al,* 2002: *Botanic Nomenclature for Agroforestry Species Index*, ICRAF, Nairobi,197 p.
Kindt R, Lillesø J-P B, and van Breugel P. *Potential Natural Vegetation for South-Western and Central Kenya.* A tool for the selection of indigenous tree species. Guidelines for identifying indigenous tree species. ICRAF Nairobi, Kenya. 13pp

Maundu P and Bo Tengnais (Eds), 2005: *Useful trees and shrubs for Kenya*, technical handbook no. 35, ICRAF, Nairobi 484 p.

Ojiambo, 1978: *The trees of Kenya*, Kenya Literature Bureau, Nairobi, 105 p.

3. Maps

GBM, GIS Lab, 2009: *AFD-GBM Project Site Map,* 1:230 000

GBM, GIS Lab, 2009: *Baseline Survey Sampling Sites* – AFD1:220 000

KWS, (no date): *A map of Aberdare National Park*, 1:40 000

Republic of Kenya, (no date): *Exploratory soil map and agro climatic zone map of Kenya, 1:1000000, Exploratory Soil Survey Report no. E-1*

Survey of Kenya, 1981: *Map of Nyeri, 1:250 000*

Survey of Kenya, 1980: *Map of Nairobi, 1:250 000*

Survey of Kenya, 2000: Topographic map of Oljoro Orok, sheet no. 119-2, 1:50 000

Survey of Kenya, 2000: Topographic map of Gilgil, sheet no. 119-4, 1:50 000

Survey of Kenya, 2000: Topographic map of Ndaragwa, sheet no. 120-1, 1:50 000

Survey of Kenya, 2000: Topographic map of Ongobit, sheet no. 120-2, 1:50 000

Survey of Kenya, 2000: Topographic map of Kipipiri, sheet no. 120-3, 1:50 000

Survey of Kenya, 2000: Topographic map of Nyeri, sheet no. 120-4, 1:50 000

Survey of Kenya, 2000: Topographic map of Naromoru, sheet no. 121-1, 1:50 000

Survey of Kenya, 2000: Topographic map of Karatina, sheet no. 121-3, 1:50 000

Survey of Kenya, 2000: Topographic map of Naivasha, sheet no. 133-2, 1:50 000

Survey of Kenya, 2000: Topographic map of Kinangop, sheet no. 134-1, 1:50 000

Survey of Kenya, 2000: Topographic map of Kangema, sheet no. 134-2, 1:50 000

Survey of Kenya, 2000: Topographic map of Kijabe, sheet no. 134-3, 1:50 000

Survey of Kenya, 2000: Topographic map of Mangu, sheet no. 134-4, 1:50 000

Survey of Kenya, 2000: Topographic map of Makuyu, sheet no. 135-3, 1:50 000

Survey of Kenya, 2000: Topographic map of Ol doinyo Onyoke, sheet no. 147-2, 1:50 000

Survey of Kenya, 2000: Topographic map of Limuru, sheet no. 148-1, 1:50 000

Survey of Kenya, 2000: Topographic map of Kiambu, sheet no. 148-2, 1:50 000

Survey of Kenya, 2000: Topographic map of Thika, sheet no. 149-1, 1:50 000

Tourist Maps (K) Ltd., 1996: *The Aberdares National Park and Environs, including Lake Nakuru and Hell's Gate National Parks*, 1:150 000

Tourist Maps (K) Ltd., (no date): *A tourist safari map of Kenya*, 1: 1 500 000

4. Other publications

Basweti C. 1999: *Nasari za Miche, mwongozo wa wenye nasari kwenye vitongoji vya miji*, Tech. pamphlet No.3, ICRAF/RELMA, 43p.

Central Bureau of Statistics, 2003: *Geographic dimensions of well being in Kenya, where are the poor? From districts to locations*, Volume 1, CBS, 164 p.

DRSRS, CBS and ILRI, 2007: *Natures Benefits in Kenya, an atlas of Ecosystems and Human Well-being*, World Resources Institute, Washington, 148p.

EGIS BCEOM, ACT and CIRAD, 2008: *Bridging the Gap Upper Tana (Githanja) Catchment Management Project*, Final Report, 164p.

Emerton L. and Mogaka H. 2001: *Participatory environmental valuation of forest resources in the Aberdares, Kenya,* PLA Notes (1996), Issue 26, IIED, London, pp. 6-10

FAO. 2007: *Forests and Water,* in Unasylva, vol 58, No. 229, FAO 72 p.

FAO,2009: *A living Forestry Strategy for SFE Countries*, FAO Strategy for Forestry Development in Eastern Africa, Addis Ababa, Feb 2009, 26p.

GOK, 2009: *Rehabilitation of the Mau Forest Ecosystem*, A Project concept prepared by the Interim Coordinating Secretariat, Office of the Prime Minister, 19p.

Hamilton A. (ed), 2008: Medicinal Plants in Conservation and Development, Plantlife Intern, 88p

ICRAF, GTZ & University of Hohenheim 2009: *Toolbox for Agroforestry Landscapes*, waterflow, carbon stocks, land tenure, markets etc (DVD)

ISRIC: 2007: *Farmers' adaptation of soil and water conservation: potential role of payments for for watershed services*, Green water credits report N°5, 63 p

Kagombe J.K. and J. Gitonga, 2005: *Plantation establishment in Kenya, the Shamba system case stud*y, KFWG, Nairobi 28p.

Kagombe J.K et al., 2005: *Management, Socioeconomic Impacts and Implications of the Ban on Timber Harvesting* in KFWG Policy Brief No.1, July 2005, 4p

Kairo J.G., 2008: *Experiences with Payments for Ecosystem Services in* Kenya in ETFRN, No. 49 pp107-111.

Kameri-Mbote P., 2002: *Property Rights and Biodiversity Management in Kenya*, ACTS press, Nairobi, 260p.

Kigomo B., (no date) : *The role of indigenous food and tree crops in combating deforestation* – case study in Kenya, KEFRI, pp. 61-70

KFWG, 2008 : *The Forest Act 2005: An empty promise or a reality*? Policy Brief N°2, Oct. 2008, Kenya Forests Working Group, Nairobi 4p.

KFS, 2007: *Proposal for the implementation of the plantation establishment and livelihood improvement scheme (PELIS) in forest reserves*, Phase 1, Planning and Reforestation Branches, 21 p.

KFS and KFWG, 2007. *Manual of Participatory Forest Management Plans* (PFMP), Nairobi 36p.

KFS and KFWG, 2007 *Participatory Forest Management Guidelines*, KFS, Nairobi 44 p.

KWS, 1999: *Aerial survey of the destruction of Mt. Kenya, Imenti and Ngare Ndare Forests Reserves*, 26 p.

Louppe, D., Oteng-Amoako, A.A. & Brink, M. ***(Eds),*** 2008**.** *PROTA 7(1): Timbers 1*

Plant Resources of Tropical Africa. Wageningen, Netherlands. 704pp**.**

Lwakuba A. and al, 2003: *Agroforestry Handbook for the montane zone of Uganda*, Technical Handbook No.31, ICRAF/RELMA, 111p.

Maimbo M and al., 2006: *Rainwater harvesting innovations in response to water scarcity***,** the Lare experience, ICRAF/ RELMA Tech. Manual No.5, 41 p.

Mogaka H et al., 2001: *Economic aspects of Community involvement in Sustainable Forest Management in Eastern and Southern Africa*, Forest & Social perspectives in Conservation n° 8, IUCN Eastern Africa Programme, May 2001**,**150 p.

Moir K and al.: 2007 *Growing trees and gardens for life, practical tips for healthy tree nurseries and home gardens*, ICRAF, Nairobi, 88p.

Muchiri G. 2008: *Residents unite to protect Kipipiri Forest*, Daily Nation, Dec 9, 2008, web edition, http://www.natioen.co.ke/News/regional/-/1070/500380/-/item/0/-/126jti2/-/index.html

Mumma A. 2005: *Kenya new water law: an analysis of the implications for the rural poor*. Johannesburg, SA 26th – 28th January 2005, 13p.

Musingo T.E and al, 2007: *Participatory Natural Resources Management*: How to Involve local communities, a handbook for facilitators, KEFRI, Nairobi, 48p.

Muturi S. N., 1992: *Curriculum for In-service Training in Agroforestry and Related Subjects in Kenya,* SIDA's Regional Soil Conservation Unit RSCU, Technical Handbook No.1, 81 p.

Muturi S. N. (Ed): 2001: *Marketing of Smallholder Produce***,** A synthesis of case studies in the highlands of central Kenya, RELMA/SIDA, 56p.

Nganga E.M. and Kamende L. M., 1990 : *The vegetation of Aberdares mountain ranges*, DRSRS report n° 138, 35 p.

Njuguna P. Mbegera M. and Mbithi D. 1999: *Reconnaissance survey of Forest blocks in the West and East of the Rift Valley*, PPCSCA, Nairobi, 43p.

Ongugo Paul and Njuguna J W, 2004. *Effects of decentralization policies on forest management: experience from seven forests in Kenya*, IFRI/KEFRI, 26p

Republic of Kenya, Ministry of Agriculture, 2008: Agriculture, Livestock, Fisheries and Rural Development Sector Medium-Term Plan 2008 – 2012, CPPMU, Nairobi, 62p.

Routsalainen A, 2004: *Kenya Forestry Master Plan recognition of local forest users*, in Pellikka P *and a*l (Eds), Taita Hills and Kenya, 148p.

Tanui J., 2006: *Incorporating a Landcare Approach into Community Land Management Efforts in Africa, a case study of the Mount Kenya Region*, African Highlands Initiative, Working papers No. 19, 16p.

Taylor P. and Beniest J., 2003: *Training in Agroforestry*, A toolkit for trainers, ICRAF, Nairobi 252p

Thenya T et al, (no date): *Participatory Forest Management Experiences* in Kenya (1996-2007), KFWG, Nairobi 42 p

UNEP, KWS, Rhino Ark and KFWG, 2003: *Aerial survey of the destruction of the Aberdare Range Forests*, 37p. + annexes (18 maps)

UNEP, KWS, KFWG and ENSDA, 2005**:** *Maasai Mau Forest, Status Report*, Nairobi, 32 p.

Wahome T., 2003: *Loggers shift sight to Aberdare*, Daily Nation, July 23, 2008, web edition http://www.nationaudio.com/News/DailyNation/Today/News/Spotlight445.html

Waithaka J. , 2001 : *Elephants as seed dispersal agents in Aberdares and Tsavo National Parks, Kenya,* in Pachyderm N°30, pp. 70-74

Wass P. Ed. , 1995: *12 Kenya's Indigenous Forests, Status, management and Conservation*, IUCN, Forest Conservation Programme, IUCN/ODA, 135p. + Appendices

WRI, 2007 :*Nature's Benefits in Kenya: An Atlas of Ecosystems and Human Well-Being*, WRI/Dept of Resource Surveys and Remote Sensing, MENR, Kenya; Central Bureau of Statistics, MPND, Kenya and ILRI, (http://www.wri.org/publication/natures-benefits-in-kenya)

Young T.P. ,1996**:** *High Montane Forest and Afroalpine Ecosystems,* in McClanahan T.R and Young T.P, East African Ecosystems and Their Conservation, Oxford University Press, New York, 452 p.

Appendix 5: Interviews Guidelines

5.1: Focus group discussions with tree nursery groups: interview guide

PRELIMINARIES:

- Welcome remarks
- Introductions of participants and consultants
- Setting the agenda-Brief introduction of the objective of the mid-term review
- Description of how the FGD will be conducted
- Introducing the statistical form-to be filled with the TNG officials
- Starting the FGD open dialogue

FGD OPEN DIALOGUE GUIDE:

A) Choice of Tree Species:

1. How does the group chose the public places to plant trees? ----probe criteria
2. How does the group chose which species of tree seedlings to raise?

B) Compensation Scheme:

3. Are you happy with the compensation scheme of GBM-why or why not?
4. How do you verify your surviving trees for compensation?
5. How have you applied the money you get fro the GBM compensation scheme?
6. What do you think will happen with to the trees when your two year compensation scheme with GBM comes to an end?

C) Communication and Monitoring

7. Are there any problems you find in communicating with GBM secretariat

D) Training and Empowerment

8. What kind of training have you received from GBM

E) Motivation for GBM membership

9. What keeps you attracted to GBM?

F) Impacts

10. What would you say is your greatest gains so far this Project?
    - To individuals-----later follow up some of these by home visits
    - To your TNG?
    - To the larger community?

H) Perception of Challenges And Opportunities

11. What challenges are you facing in your endeavor of planting trees in forests/public lands

12. What improvements would you like to see in this Project?

I) Closing the FGD

13. What else would you want to let us know that we have not touched on in these discussions?

5.2: Interview questionnaire guide for extension officers, green volunteers and green rangers

Extension Officers

1. What is the length of the time you have stayed in the GBM?
2. Please describe to us your major responsibilities the way you understand and execute them
3. What types of training have you received in GBM in connection with your work?
4. What would you say are the major successes/achievements of this Project so far?
5. What do you think are the challenges facing TNGs and their mission of planting trees in forests and public lands at present?
6. What challenges have you faced yourself in your work and how did you respond to them?
7. What would you say have been your major achievements as an Extension Officer?
8. How do you think the TNGs can be further developed?
9. What else would you like us to know on this Project which we have not touched already?

Green Volunteers

1. How long have you associated with the GBM as a GV?
2. What motivated you to volunteer as a GV?
3. Please describe to us your major responsibilities the way you understand and execute them
4. What types of training have you received in GBM in connection with your work?
5. What do you think are the challenges facing TNGs as they pursue planting of trees in forests and public lands at present?
6. What challenges have you faced yourself in your work and how did you respond to them?
7. What would you say have been your major achievements as a GV?
8. How do you think the TNGs can be further developed?

Green Rangers

1. How long have you worked as a GR?
2. Please describe the major aspects of your work as a GR?
3. What kind of training did you receive from GBM in connection with your work and in general?
4. What can you point out as outstanding successes of the tree planting in forests so far?
5. What do you think are the challenges facing TNGs as they pursue planting of trees in forests and public lands?
6. What challenges have you faced yourself in your work and how did you respond to them?
7. What do you think can be done so as to improve your work and the success of the TNGs in planting trees in the forests?

Appendix 6: GBM ten steps procedure (Revised in 2007)

Step 1: Importance of trees (Why is this work Important)

• In a workshop or public meeting e.g. chief's *baraza*, church meeting etc, discuss **BENEFITS** of trees focusing on the following points:
• Building materials, firewood, wind break, prevention of soil erosion, humus, shade, beautify the region, fencing materials, food, fodder, air purification, traditional medicine, dye, glue, papers, pencils, spices, and linkages to a peoples livelihood. Civic and environmental outreach seminars are also conducted to reach and mobilize communities and their leaders and other important stakeholders.

Step 2: Group formation (Deciding to take the first step)

• Writing down the list of members.
• Naming the group.
• Election of officials. By secret ballot.
• Group to discuss the site and members code of conduct.
• Officials to look for site.
• Invite GBM staff member to assist the group.
• Apply to the GBM headquarters through GBM Forester.

Step 3: Registration (Formalizing a working structure)

• Group to receive registration form.
• To read and fill the form.
• Officials to sign the form.
• Attach the list of members.
• Send to the headquarters through GBM Forester and retain a copy.
NB: Every form must have the name and address of the group.

Step 4: At the nursery site (Getting the tools and equipments needed)

• Group to agree on a good site, clear the site, collect seeds, make seedbeds, sow seeds, shade and continue watering.
• Put soil into polythene tubes and arrange for easy watering, transplanting and record keeping i.e. according to species or size for proper growth.
• Group to register with the CDA, a government official.
• Continually survey the species needed for planting (on private and public lands) and monitor flowering and seeding, continue seed collection for own use and exchange with other groups.

Step 5: Quarterly report (Forming the sub-location Network)

• Group to get from secretary their record book and read form V.
• After reading, consult field staff i.e. Green Volunteers, Field Facilitators, GBM Forester.
• Count potted seedlings and record.
• Count and record trees ready for planting according to species.
• Count and record trees not ready for planting according to species.
• Filling form V, confirm accuracy, sign and give to group secretary to show the Green Volunteer for further analysis in the nursery card.
• With the help of GREEN VOLUNTEER; each group to elect two of their members to the network committee that will oversee the work of tree nursery groups in a sublocation. After electing network leaders from the committee, the leaders elected open a bank account for their network and send account names to the office through GBM forester.

Step 6: Stakeholders consultations and involvement (looking at the external factors related to the work)

• Network to get from secretary their record book and read form VI. *NB: Advice from GREEN VOLUNTEER*.
• The network assisted by network committee identifies public lands where tree species in their nursery would be suitable if planted.
• Promotion to stakeholders in each public land within a radius of not more than 5 km to plan with them species and numbers to be planted is necessary. Where public lands are further than 5 Km the GBM forester and other networks should be involved in the consultations and planning to pool resources (transport, tools, people) together.
• Record in form VI all the stakeholders consulted and willing to participate in trees planting.
• Network officials sign the filled form VI; give to group secretary to show the Green Volunteer for further analysis in the nursery card
More guidance by GBM Forester on Protocol to use in Gazetted and Trust lands is necessary to link the community with government departments concerned.
At this stage; Explaining the tree planting purpose and plan, and expected roles and results should be done with the assistance of GBM forester. The forester will also write an assessment report of the site including: site details, name and coordinates; names of networks to work in the site; hectareage and existing vegetation; bordering vegetation/areas; site accessibility; tree species suitable for planting and possible risks to the establishment of specific species selected for the site; IGAs and aftercare requirements suitable/ required for site being assessed.

Step 7: Mobilizing community members to dig holes

• Network to get from secretary their record book and read form VIII.
• Network to dig holes and assisted by GV guide the other community members in digging holes.
• Record in form VIII the nursery groups that participated in digging holes and number of holes dug.
• Network officials sign the form and give to group secretary to show the Green Volunteer for further analysis in the nursery card
• Manure holes and put mulch nearby where necessary.

• Agree on tree planting dates and inform headquarters.
Assisted by GBM forester, hold a meeting of all network committee members: make planting plan, discuss sites details and stakeholders concerned, discuss objectives of the restoration of the site, discuss challenges and formulate possible solutions, formulate a broad 10 year plan and specific and detailed first year plan with roles and responsibilities. Share plan with the office, and stakeholders

Step 8: Tree Planting

• Network to get from secretary their record book and read form IX.
• With the help of the committee members they pack seedlings, transport and plant as per holes dug.
• Green Volunteer and network officials to explain the way to plant trees and how to recycle the polythene tubes.
• Mulch planted trees to control weeds and conserve moisture
• Record in form IX trees planted as per nursery group and species planted.
• Network officials sign the form, give to group secretary to show the Green Volunteer for further analysis in the nursery card
GBM forester and GV guides the network committee to engage stakeholders (livestock owners, immediate neighbors to the site, land owners, local leaders, and resource users) and organize one planting event that involves them.

Step 9: First follow-up (continuous follow-up)

• Network to get from secretary their record book and read form VII for first follow-up.
• GV assists network to follow-up trees with this form at least one month after planting.
• Check seedlings establishment, mulching, weeding and watering as necessary and record the survivals as per species: if planted trees are 5000 and above a green ranger can be engaged by the network with the confirmation of the GBM forester.
• Note any challenges to trees establishment and record on the form
• Network officials sign the records; give to group secretary to show the Green Volunteer for further analysis in the nursery card.
• Replant non-performing seedlings and agree on a date to record surviving trees in a final follow-up.
Network agree on best way to nurture or keep an eye on surviving trees possibly by initiating a bee keeping/ fodder collection/ students learning/ picnics, birds watching in the planted area.
BURSARIES or by electing one member as a green ranger.

Step 10: Final follow-up

• Network to get from secretary their record book and read form 12
• Follow up is done 3 - 6 months after planting.
• Count surviving trees and record survivals as per species and nursery group that provided the trees
• Network officials sign the form; give to group secretary to show the Green Volunteer for further analysis in the nursery card.
• Headquarters to process compensation for all surviving trees (5 * # established)
• Take the compensation to the network, validate the accuracy of survivals and give the cheque and ideally participate in an on going tree planting event. The first payment of Green Ranger if any is also taken to the network to give.
• Network to confirm receiving the cheque by signing payment voucher sheet together with the GBM forester or other staff member who could have taken the cheque.
• Deposit cheque and cash for the nursery groups whose seedlings survived i.e. are established.
• Group to confirm to the headquarters that they received their compensation from network through meeting minutes that are forwarded to the GBM forester.

Network informs headquarters any activities they are initiating in the reforested public lands for further planning and support.

Appendix 7: Climatic data for the Aberdare range and adjacent regions

Stations	**Altitude (m)**	**Coordinates**		**Rainfall (mm)**												
		Long E	Lat S	J	F	M	A	M	J	J	A	S	O	N	D	**Total**
Aberdares Nat. Park	2600	36.37	0.32	72	105	208	373	323	91	105	125	110	321	325	125	**2283**
Dagoretti Sta. - Nbi	1798	36.45	1.18	38	45	87	223	195	35	15	20	20	53	134	113	**978**
Geta Forest Station	2600	36.37	0.28	50	46	83	152	158	95	98	109	122	109	93	70	**1185**
Karatina Agric Sta.	1760	37.08	0.29	47	54	76	370	279	44	40	60	58	205	182	93	**1508**
Kiambu Dist Office	1700	36.50	1.10	46	52	114	231	167	51	24	27	32	67	149	83	**1043**
Kieni Forest Station	2500	36.40	0.51	61	84	135	334	276	58	43	57	53	136	242	242	**1721**
Kikuyu Dist Office	1970	36.40	1.15	52	51	99	203	203	27	20	21	9	60	169	100	**1014**
Limuru Uplands	2300	36.38	1.07	76	47	85	275	263	49	31	49	33	91	152	97	**1248**
Murang'a - Gateigor				46	43	136	416	284	44	35	57	41	157	245	97	**1601**
Naivasha	1880	36.26	0.43	34	40	51	105	80	44	43	52	31	46	64	46	**636**
Nanyuki	1860			24	33	75	137	101	36	40	64	44	102	119	53	**828**
Nyahururu	2378			20	16	43	160	135	112	101	127	70	42	75	49	**950**
Nyeri	1815			36	32	79	183	201	33	32	35	33	106	102	87	**959**
North Kinangop	2630	36.38	0.35	39	52	90	173	160	109	71	91	103	96	95	58	**1137**
Ol Kalou	2360			22	18	39	99	100	84	105	115	51	44	58	22	**757**
South Kinangop	2550			54	60	112	231	191	70	46	58	49	87	112	72	**1142**
Thika	1549	37.04	1.20	33	31	117	214	89	24	15	11	20	85	155	100	**894**

Stations	**Altitude (m)**	**Coordinates**		**Average temperatures (° C)**												
		Long E	Lat S	J	F	M	A	M	J	J	A	S	O	N	D	**Mean**
Aberdares Nat. Park	2600	36.37	0.32	9.9	10.4	10.9	11	10.2	9.1	8.4	8.4	9.2	10.2	10.2	9.6	**9.8**
Dagoretti Sta. - Nbi	1798	36.45	1.18	17.3	18.0	18.3	18.0	16.9	15.4	14.4	14.9	16.2	17.6	17.3	17.0	**16.8**
Geta Forest Station	2600	36.37	0.28	13.3	13.7	14.1	14.0	13.4	12.3	11.7	11.8	12.3	13.1	13.0	12.9	**13.0**
Karatina Agric Sta.	1760	37.08	0.29	17.3	18.1	18.7	18.5	17.8	16.8	16.1	16.1	17.3	18.3	18.4	17.1	**17.5**
Kiambu Dist Office	1700	36.50	1.10	19.1	20.0	20.1	19.6	18.4	16.9	16.0	16.4	18.0	19.2	18.9	18.7	**18.4**
Kieni Forest Station	2500	36.40	0.51	13.5	14.0	14.3	14.1	13.3	11.9	11.0	11.1	12.1	13.4	13.4	13.2	**12.9**
Kikuyu Dist Office	1970	36.40	1.15	16.6	17.2	17.6	17.0	15.8	14.4	13.5	14	15.3	16.6	16.3	16.2	**15.9**
Limuru Uplands	2300	36.38	1.07	15.1	15.7	15.9	15.4	14.3	12.9	12.0	12.3	13.7	15.0	14.7	14.6	**14.3**
Murang'a - Gateigor				18.9	19.8	20.3	19.8	19.0	17.9	17.1	17.1	18.4	19.6	20.3	18.7	**18.9**
Naivasha	1880	36.26	0.43	17.8	18.2	18.5	18.2	17.5	16.5	15.8	16.0	16.6	17.2	17.0	17.2	**17.2**
Nanyuki	1860			15.9	16.4	16.9	16.8	16.3	15.7	15.3	15.3	15.7	15.9	15.5	15.3	**15.9**
Nyahururu	2378			15.2	15.6	16.2	16.2	15.7	14.8	14.4	14.3	14.5	15.1	15.1	15.1	**15.2**
Nyeri	1815			16.8	17.5	18.0	18.0	17.4	16.3	15.6	15.7	16.7	17.6	17.5	16.5	**17.0**
North Kinangop	2630	36.38	0.35	12.2	12.6	13.2	13.2	12.5	11.2	10.5	10.6	11.2	12.3	12.4	12.0	**12.0**
Ol Kalou	2360			14.5	14.9	15.4	15.2	14.8	13.7	13.3	13.3	13.5	14.1	14.1	14.1	**14.2**
South Kinangop	2550			11.5	11.7	12.5	13.0	12.1	10.7	10.3	10.2	10.6	11.8	12.0	11.3	**11.5**
Thika	1549	37.04	1.20	19.8	20.3	21.2	21.3	20.3	18.8	17.7	18.2	19.7	20.7	20.1	19.7	**19.8**

Source: Google Earth and Kenya Meteorological Department

Appendix 8: The logical framework of the Project

Objectives	**Performance indicators**	Means of verification	Assumptions
Development objective : Secure and regulate water supply of Kenya by rehabilitating a watershed forest ecosystem	**Impacts indicators** • National forest cover rate • Level of river flows • Level of water supply in dry seasons	• National statistics	The government of Kenya confirms that natural resources sustainable management is a priority. INCREASING THE INDIGENOUS FOREST COVER LEADS TO INCREASED AND BETTER REGULATED WATER FLOWS
Specific objective : **Restore and protect, by supporting the civil stakeholders, the Aberdares watertower which supplies a large part of agricultural arid or semi-arid Kenya** **Specific detailed objectives :** • **Rehabilitate, specially by women groups, the degraded areas in the Aberdares gazetted forests watersheds, by planting indigenous tree species, in order to restore forest hydrology, soils and biodiversity** • **Support and diversify in a sustainable way the livelihoods of the forest adjacent communities by generating planting incomes and by promoting alternative and profitable forest uses** • **Disseminate the forest protection initiatives by the NGOs and women groups** • **Create the conditions for replicating a pilot Project for full-rehabilitation of watershed catchments forests ecosystems**	**Outcome indicators** • **Forest cover rate in the Aberdare Range** • **Forest cover rate in the Project areas** • **Number of new innovative micro-Projects for sustainable use of the forest** • **Number of sensitisation worships** • **Number of advocacy technical documents and events about the "Aberdare success story"**	• Aerial survey, if available • Aerial survey, if available • Annual technical reports of the Project	The 2005 new Forest Act is enforced to protect the watershed forest ecosystems in collaboration with the communities The Green Belt Movement successfully adapts its private land 10-step procedure to indigenous gazetted forest ecosystems.

Objectives	**Performance indicators**	Means of verification	Assumptions
Outputs :	**Outputs indicators**		
Component 1 : Rehabilitation of the degraded areas of the Aberdare forest ecosystem in the public lands • Forest ecosystems rehabilitated • Relevant skills introduced in communities for tree planting and protection • New livelihoods promoted for the sustainable use of the forest ecosystems, especially for women	• Number of trees planted (target : 2 millions) • Planting trees success rate • Amount of compensations paid to communities and women groups • Number of new innovative micro-Projects for sustainable use of the forest	• Follow up records • Accountability of the Project • Annual technical reports of the Project	The Green Belt Movement gets support from the Forest Department, KEFRI and ICRAF for selecting and collecting indigenous seeds and planting indigenous trees. The Forest Department and the Kenya Wildlife Service contribute to the protection of the indigenous plantations Alternative livelihoods are adopted by communities and reduce the pressure on the forest but these effects are not thwarted by a general increasing of poverty.
Component 2 : Public and institutional awareness and training, dissemination and communication • New consciousness in the communities for sustainable forest ecosystems management • Environment friendly and sustainable forest management public policies promoted • Outcomes of a watershed forest rehabilitation pilot Project disseminated throughout the remaining four watertowers of the country and beyond	• Number of groups and tree-nurseries created in the Project area (target : 280) • Number of new Forest Associations • Number of women involved • Number of local and national events on water sheds protection and tree-planting • Number of visitors on the website • Number of sharing experience events with the other water-towers	• Annual technical reports of the Project • Minutes of meetings • Annual technical reports of the Project • Electronic count • Annual technical reports of the Project • Events proceedings and minutes	The 2005 Forest Act is enforced, which legalizes the Forest Associations and the co-management of forest resources.
Activities :	**Inputs indicators**		
Component 1 : Rehabilitation of the Aberdare forest ecosystem in the public lands • Communities and stakeholders mobilization and training • Field training facility • Planning and following tree planting • Tree planting and nurturing	**1,290,000 €** 100,000 € 60,000 € 80,000 € 1,050,000 €	• Annual technical reports of the Project • Follow up of the expenses • Technical and financial audits reports • External evaluations	
Component 2 : Public and institutional awareness and dissemination and communication • Local lobbying and networking • National and pan African dissemination	**180,000 €** 100,000 € 80,000 €		
Component 3 : Project monitoring and management • Global Project management • Project monitoring and evaluation • Technical Assistance	**585,000 €** 225,000 € 60,000 € 300 000 €		
Component 4 : Contingencies	**50,000 €**		

Source: AFD/BRL Feasibility Study 2006

Appendix 9: List of the Extension Officers of GBM/AFD Project and their qualifications

Constituency	Extension Officers	Qualification
Gatanga	Christopher Wamugunda	Degree environmental science /Diploma in Project management.
Gatundu North	Jane Olive Wanjiku	Diploma in Forestry
Gatundu South	Pretty Joy Karwitha	Diploma in Forestry
Githunguri	David Kimani-GV	
Kangema	Samuel Gathu	Degree in environmental studies
Kigumo	Ashiphord Kamau	Diploma in Forestry
Kiharu	Monicah Wangari	Degree in environmental science
Kipipiri	Reuben Nduati	Diploma in Forestry
Lari	Edward Muguheli	Diploma in Forestry
Limuru	Anne Githaiga	Diploma in Forestry
Mathioya	Joseph Kimani	Degree in environmental science
North Kinangop	James Mwangi	Diploma in Forestry
South Kinangop	Geoffrey Kungu	Degree in environmental science/ Diploma in Forestry

Appendix 10: Green Volunteers (GV) and Green Rangers (GR) of the AFD/GBM Project and corresponding households

10.1: Number of Households, Green Volunteers and Green Rangers as at June 2009

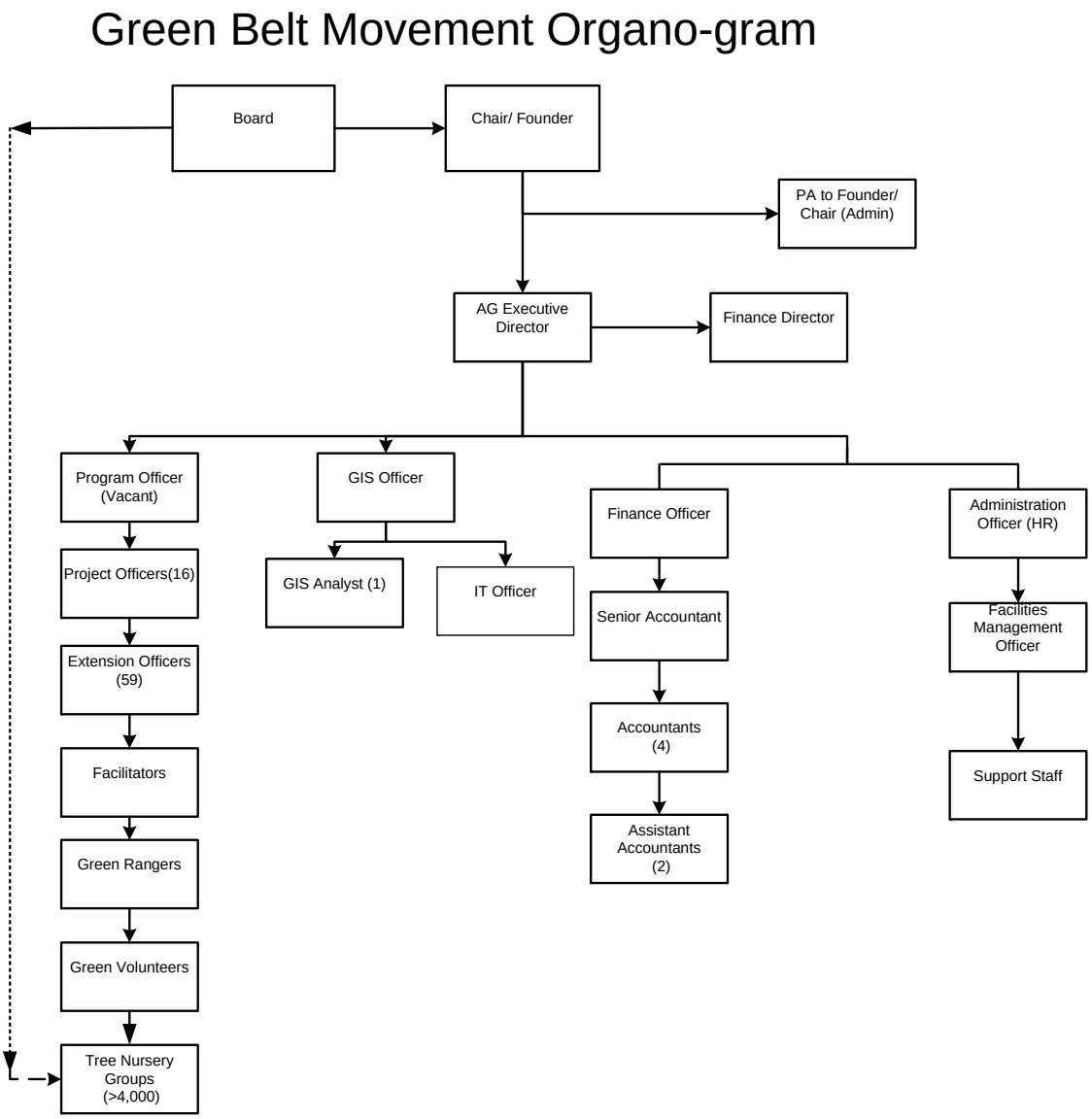
Constituency	Households	GV	GR
Gatanga	833	7	
Gatundu North	313	6	
Gatundu South	489	11	7
Githunguri	87	2	
Kangema	645	6	2
Kigumo	625	7	2
Kiharu	859	9	
Kipipiri	586	6	6
Lari	1629	12	10
Limuru	298	6	
Mathioya	309	7	1
North Kinangop	390	5	1
South Kinangop	514	4	1
Total	**7577**	**88**	**30**

10.2: List of Green Volunteers and Green Rangers per constituency

Constituency	GV	GR
Gatanga	- Chege Peter - Kabuka Jacinta - Kinuthia Kamau - Muguero Samuel - Mutuara Francis - Mwangi John - Thuri Daniel	NONE
Gatundu North	- Gitau Simon - Karimi Francis - Kariuki Geofrey - Kimani Fredrick Bell - Koigi Paul - Wanjihia Gabriel	NONE
Gatundu South	- Chege Jacob - Gachora Samuel - Kariu Caroline N - Kariuki John - Kimotho Samuel Karanja - Muia Paul - Njuguna Mbukia David - Wanjiru Salome - Wanjiku Isabella - Wanjiku Catherine - Waweru Philip -Njoroge	- Gathoni Lucy - Gichohi Philip - Kimani Paul - Njeri Jane - Njoroge Peter - Mwangi Josphat - Waruingi John
Githunguri	- Kimani David - Ngaba Washington - Njoroge	
Kangema	- Kagai Jane Njoki - Muchiri Patrick - Murefu Peterson - Mwangi Paul Kamotho - Ndiruka Paul - Nbugiri Joseph	-Waweru Michuki Wilson -Waithaka Stephen Kirigwe
Kigumo	- Gachie James - Karanja Wanjiru - Maina Ann - Maina David - Muriu Francis	-Gishiri Joseph - Mureu Francis
Kiharu	- Mbogoro John - Mwangi Gerald Kinyanjui - Mwangi Monicah - Ngendo Alice - Nyambura Pauline	NONE

	- Thiongo Samson - Wangari Anne - Wanjiru Anne	
Kipipiri	- Kamau Kigwa Peter - Kinyanjui Francis - Komu Rahab - Macharia Wanjohi Paul - Nganga Gathubi Peter - Ndirangu Maniki Godfrey -Ndingari	-Kabonga Joshua Njuguna -Komu Richard -Macharia Jacob -Mburu James -Mwangi Kamau Joseph -Ndirangu Mukabi Peter
Lari	- Gacheru Paul - Gioko Wilson - Kamau Francis - Maina Reuben - Mathu Joseph - Ndungu Mwaura - Njuguna Monicah - Nyakio Naomi - Waiya Paul Kibue - Wamugumo Mugo - Waruingi Joseph	- Chege John Kihubo - Chege Samuel - Kamau Choru James - Kamau Kariuki John - Kibiru Mwai Johnson - Mwaura Karanja James - Ngugi Wainaina Patrick - Njuguna Wainaina James - Njoroge Paul Nduati - Wairimu Ibrahim Mburu
Limuru	- Hungura Jackson - Karanja Charles - Mbuga Ishmael - Ngugi Ndirangu - Roita Eliud - Waititu Peter	NONE
Mathioya	- Gichuki Kimathi - Irungu Komu George - Kangethe Josphat - Kariuki James - Ndumo Oliver - Wahito Eizabeth - Wanjiru Zewaria	Mwangi Simon Wariahe
North Kinangop	- Gikonyo Samson - Gitonga Nduru - Kamau Jack - Macharia John - Wambui Eunice	- Macharia Jonnah Nderitu
South Kinangop	- Kirumba John Kihiu - Wambugu Paul - Wanyaga David Gichinga - Wanyoike Anne Wairimu	Macharia Mugo Samuel

Appendix 11: GBM Organization Chart



Appendix 12: Species planted by the AFD/GBM Project and information on some major tree species

12.1 Species planted by GBM tree nursery groups in forests and publics lands:

Botanical name	Family	Kikuyu name	Main uses
Acacia abyssinica	Mimosaceae	Mugaa	Edible gum, fuel wood, timber
Acacia xanthophloea	Mimosaceae	Murera	Fuel wood, fodder, timber
Afrocarpus falcatus (Podocarpus falcatus)	Podocarpaceae	Muthengera	Timber, medicinal
Afzelia quanzensis	Caesalpiniaceae		Timber, carving
Albizzia gummifera	Mimosaceae		Medicinal, timber, fuel, fodder
Allanblackia floribunda	Clusiaceae		
Bridelia micrantha	Euphorbiaceae		
Calodendrum capense	Rutaceae	Murarachi	Timber, fuel, ornamental
Cordia africana (Cordia abyssinica)	Boraginaceae	Muringa	Timber, fruits, fuel
Croton macrostachyus	Euphorbiaceae	Mutundu	Timber, furniture, post, medicinal
Croton megalocapus	Euphorbiaceae	Mukinduri	Shade, timber, fuel wood, medicinal
Dodonaea viscosa	Sapindaceae	Murema	
Dombeya rotundifolia	Sterculiaceae	Mutoo	Timber, fuel, fodder
Dombeya torrida	Sterculiaceae		
Ekebergia capensis	Meliaceae		Timber
Erythrina abyssinica	Papilionaceae		Fodder, carving, seeds, medicinal
Ficus natalensis	Moraceae	Mugumo	Medicinal, bark for fibres
Fraxinus pennsylvanica	Oleaceae	Munyukwa	Timber, fodder, windbreaks; exotic
Grevillea robusta	Proteaceae	Mukima	Timber, fuel, fodder; exotic species
Hagenia abyssinica	Rosaceae	Muthithiku	Timber, carving, fuel, medicinal
Juniperus procera	Cupressaceae	Mutarakwa	Timber, poles, medicinal
Kigelia africana	Bignoniaceae	Muratina	Medicinal
Macaranga capensis (M. kilimandscharica)	Euphorbiaceae		
Markhamia lutea	Bignoniaceae	Muu/muho	Poles, timber, mulch, medicinal
Moringa oleifera	Moringaceae		nutrition, food security
Nuxia congesta	Loganiaceae	Mwanda	Fuel wood
Ocotea usambarensis	Lauraceae	Muthaiti	Timber
Olea europea ssp africana	Oleaceae	Mutamaiyu	Timber, charcoal
Olea capensis	Oleaceae		Timber
Podocarpus latifolius	Podocarpaceae	Muthengera	Timber, medicinal
Polyscias kikuyensis	Araliaceae	Mutati	Boxes, bee hives, plywood
Prunus africana	Rosaceae	Muiri	Medicinal (bark), timber, fuel
Rauvolfia vomitoria	Apocynaceae		Medicinal
Schinus molle	Anacardiaceae	Mugaita	Ornamental, edges - exotic

Sinarundinaria alpina (Arundinaria alpina)	Poaceae	Murangi	Bamboo
Spathodea campanulata	Bignoniaceae		Fuel wood, medicinal
Syzygium cordatum	Myrtaceae	Muriru	
Syzygium guineense	Myrtaceae	Ngoe	Timber, edible fruits
Tamarindus indica	Caesalpiniaceae		Medicinal, timber, fruits
Trema orientalis	Ulmaceae		Soil fertility ,forage, medicinal,
Trichilia emetica	Meliaceae	Mururi	Medicinal, furniture, poles, fuel wood
Vepris nobilis (Teclea nobilis)	Rutaceae		Carpentry, harpoon (spear), fuel wood
Vitex keniensis	Verbenaceae	Mhuru	Fruits, timber
Warburgia ugandensis	Canellaceae	Muthiga	Glue resin, furniture

12.2: Information on some major tree species

***Acacia xanthophloea* Benth.**
Vernacular names: Fever tree, sulphur bark, African thorn acacia

Acacia xanthophloea occurs from Somalia south to northern South Africa and Swaziland.

Description: Medium-sized tree up to 25 m tall; bole straight, up to 60 cm in diameter; bark smooth and powdery, lemon yellow to greenish yellow; crown open, with spreading branches; young branches first purple then yellowish, with paired, straight stipular spines up to 7(–8.5) cm long. Leaves alternate, bipinnately compound. Flowers small, creamy white to pinkish or purplish or yellow, fragrant. Fruit a linear-oblong pod 4–13.5 cm × 0.5–1.5 cm, straight or slightly curved, pale brown, constricted between the seeds,. Seeds orbicular to ellipsoid, smooth, brown.

Ecology: Acacia xanthophloea occurs in swampy localities and riverine forest, often on flood plains or in depressions, up to 2100 m altitude. It often grows on alluvial black clay soils. This preferred habitat, which offers ideal breeding possibilities for malaria mosquitoes, is the reason that Acacia xanthophloea was associated with malaria; hence the name 'fever tree'. It often grows gregariously and is often even dominant. The tree can tolerate moderate frost. It is nodulated by nitrogen-fixing Rhizobium bacteria.

Growth and development: The tree is deciduous. The flowers are pollinated by insects such as bees and butterflies. In southern Africa flowering occurs in September–November, fruiting in January–April. *Acacia xanthophloea* suffers stripping of bark, browsing and breakage by elephants, but exhibits high resilience to disturbance. The pods are a favourite food of vervet monkeys, which may play a role in seed dispersal. The light pod segments are probably also dispersed by wind and water.
Seed production for collection is often poor as a result of predation by animals. There are 24, 000–30,000 seeds per kg. Seeds can be stored for a long time in a dry place, but they are susceptible to insect damage. Seed should be soaked in water for 24 hours, in hot water overnight, or be mechanically scarified before sowing. Germination is generally fair, reaching

about 70% after 2 weeks. When seedlings have reached the 2-leaf stage 6–8 weeks after sowing, they should be transplanted from seedling trays into nursery bags. Care should be taken not to damage the long taproot. *Acacia xanthophloea* can also be propagated by cuttings.
The growth rate of seedlings is fast, to a maximum of 7 m tall in 3 years. A growth rate of 1.5 m/year and 2 cm in diameter are common in young trees.

Uses: Acacia xanthophloea produces a general-purpose timber, which is used in construction and for carpentry, boat building, furniture, mortars, domestic utensils, troughs and fence poles. The wood is used as firewood, although the gum leaves a black tar-like deposit when burnt. It makes good quality charcoal. *Acacia xanthophloea* is a popular garden tree In Kenya a bark decoction is used in traditional medicine to treat indigestion, and in Tanzania to treat sickle cell anaemia. In South Africa Zulu people use powdered bark as an emetic to treat malaria, and also against eye complaints. The gum, which occurs in large quantities on the trunk, is reportedly edible and is eaten by monkeys. Leafy branches are given as fodder to livestock. Trees produce good bee forage.
Acacia xanthophloea bark is traded on local markets in South Africa and imported from Mozambique.
With its open crown Acacia xanthophloea is a promising plantation tree in agroforestry systems, and its popularity as an ornamental tree is also likely to increase.

Properties: The heartwood is pale brown with a reddish tinge and distinctly demarcated from the wide, paler sapwood. It is fairly heavy, with a density of about 900 kg/m³ at 12% moisture content. It should be dried with care because it is prone to splitting and cracking. It finishes smoothly. The wood is susceptible to borer attack.
The bark contains tannin in considerable quantity, but it does not produce good leather. Bark extracts showed weak in-vitro antimalarial activity and considerable antimicrobial activity. Leaf extracts showed antibacterial activity against Staphylococcus aureus and Escherichia coli. The gum is water soluble and contains galactose, arabinose, rhamnose, glucuronic acid and 4-O-methyl-α- D-glucuronic acid.

Source: Lemmens, R.H.M.J., 2006. *Acacia xanthophloea* Benth. *In*: Louppe, D., Oteng-Amoako, A.A. & Brink, M. (Editors). Prota 7(1): Timbers/Bois d'œuvre 1. [CD-Rom]. PROTA, Wageningen, Netherlands.

Afrocarpus falcatus (Thunb.) C.N.Page

Synonyms: *Podocarpus falcatus* (Thunb.) R.Br. ex Mirb., *Podocarpus gracilior* Pilg.
Vernacular names: Yellowwood, African fern pine, weeping yew, Outeniqua yellowwood, Podo.

Afrocarpus falcatus occurs in mountain forest from Ethiopia through Kenya, Tanzania and Mozambique to eastern and southern South Africa; also in Swaziland and Lesotho.

Description: Evergreen, dioecious, medium-sized to large tree up to 45(–60) m tall; bole branchless for up to 25 m, straight and cylindrical, up to 200(–300) cm in diameter; bark surface greyish brown to reddish brown, rather smooth, flaking in irregular pieces. Leaves arranged spirally, simple and entire, narrowly linear, up to 4.5 cm long, glaucous green to yellowish green.

Male cone axillary, solitary, brownish; female cone terminal, solitary. Seed drupe-like, globose to obovoid, glaucous to greyish green, seed coat hard, woody, warty, enclosed in a somewhat fleshy, resinous integument.

Ecology: Afrocarpus falcatus occurs in forest in the mountains at 1500–2400(–3000) m altitude, often associated with *Juniperus procera* Hochst. ex Endl. It is characteristic for undifferentiated Afromontane forest, but it can also be found in rainforest. Locally it occurs in nearly pure stands. In southern Africa *Afrocarpus falcatus* is uncommon, scattered and can be found in moist coastal forest, as well as in mountain forests. It prefers places with an annual rainfall of (800–)1200–1800(–2200) mm and mean annual temperatures of 13–20°C. It is susceptible to drought; it tolerates light frost, but young seedlings are susceptible. *Afrocarpus falcatus* is characterized as a non-pioneer, shade-tolerant species. It performs best on well-drained, deep, humus-rich and light-textured soils with pH of 5–7.

Growth and development: The pollen is dispersed by wind, but most of it does not get far from the male tree. Fruiting starts when the tree is 10 years old. Seed production varies from year to year. Usually, trees bear seeds irregularly, mostly at intervals of 2–4 years. Seeds take about one year to develop. They remain on the tree for a considerable time. Fruit bats are the main dispersers; they feed on the fleshy part of the seed coat, discarding the woody part with the embryo. Colobus monkeys feed on the seeds, but also rodents, bushpig and large birds such as hornbills and turacos. However, it has been reported that seed that has passed the digestive tract of these animals usually does not germinate anymore. Seeds are commonly attacked by insects, which may cause considerable losses.
Seedlings seem to establish only after mast seed years, and usually close to the parent tree. Studies in mountain forest in Ethiopia showed that natural regeneration of *Afrocarpus falcatus* was poor.
The 1000-seed weight is 0.9–2 kg. The germination rate varies from region to region, from 40 to 90%. Seeds collected from the ground are often infected with the fungus *Penicillium claviforme*, which reduces the germination rate. The seed coat delays germination for about one year and removal of the fleshy part promotes germination significantly. Seeds germinate best at 25°C. Seeds should be dried to a moisture content below 15% before storage. The germination rate of seeds stored for 12 months at room temperature dropped to below 35%. Storage at 1°C is possible and results in a germination rate of up to 60% after 2 years. Fair seed viability was also maintained at 4°C for 4 years. *Fusarium oxysporum* and *Polyporus* sp. are pathogenic to seeds and seedlings.
Seeds can be sown into nursery bags or seed trays, and should be covered with a thin layer of soil. At the time of transplanting, care should be taken not to damage the taproot. Enhanced nutrient supply increases the growth rate of seedlings, especially at high irradiance levels.
Methods of vegetative propagation have been investigated. Leafy branch cuttings 6–11 cm long and 2–3 mm in diameter derived from stock plants of 3 months to 2 years old showed up to 80% rooting when indolebutyric acid was applied at doses of 20–80 µg per cutting. Semi-hardwood cuttings 10–12 cm long taken from 4– 5-year-old saplings treated with 2000 ppm indolebutyric acid showed a rooting rate of 45%.
Protection of plantations against fire is necessary. In South Africa trees planted in agroforestry systems showed better growth (average height 4.2 m and 90% survival after 7 years) than in plantations (average height 3.4 m and 58% survival). On fertile soils in Rwanda the annual

growth can be over 1 m in height and 1 cm in bole diameter, at least until 15 to 20 years old, and can be harvested for timber 40–50 years after planting.
Afrocarpus falcatus is self-pruning, but in plantations with wide spacing pruning operations are needed for proper bole development. The tree is very sensitive to competition, and thinning is necessary for good diameter growth. In Rwanda thinning to 50% was carried out when the trees were 15 years old, and the response was very good: at age 26 the mean annual growth in diameter was 7 mm/year in the thinned plot and only 2.5 mm in the unthinned plot.
Trials in South Africa showed that the growth rate and yield of Afrocarpus falcatus plantations (standing volume 47.7 m^3/ha 11 years after planting) and also wood quality compared favourably to those of commercial pine plantations. Mean annual volume increment over 20 years was calculated as 5.8 m^3/ha.
Trees may reach a very high age, up to 600 years. Investigation of the roots revealed the presence of arbuscular mycorrhizae.

Afrocarpus falcatus has become threatened because of selective logging for many decades, whereas the reproductive potential has rapidly declined. It is included in the IUCN Red List as vulnerable. Ex-situ conservation and provenance trials have been carried out in South Africa.
In experiments in South Africa it was demonstrated that seeds from provenances near the afforestation site showed better results after germination than those from provenances from further away.

Afrocarpus falcatus could make an excellent indigenous substitute for exotic pine tree plantations throughout its native range. Plantations have the capacity to produce valuable timber in rotation cycles of reasonable time, and they have important ecological value as well. Studies to determine the genetic variation, selection of provenances with superior wood characteristics and investigations on optimal silvicultural systems are needed. Immediate action is needed for in-situ conservation of the remaining natural stands.

Uses: Logs are susceptible to insect and fungal attacks and should be removed from the forest and converted as soon as possible after felling, or treated with preservatives.
The wood, often traded as ‘podo’ or ‘yellowwood’, is highly valued for ship building, e.g. for masts and planks, but it is also used for poles, panelling, furniture, boxes, veneer and plywood. It is suitable for construction, flooring, joinery, interior trim, mine props, vehicle bodies, railway sleepers, toys, novelties, agricultural implements, musical instruments, food containers, vats, turnery, hardboard and particle board. It is also used as firewood.
The ripe seed is edible, but resinous. Edible oil has been extracted from the seeds. The bark and seeds are used in traditional medicine. Bark decoctions or infusions are used as anodyne, also to treat stomach-ache. A bark decoction is also applied to itching rash. Pulverized seeds are applied to treat tuberculoid meningitis and sunburn. In Ethiopia the seed oil is used in the treatment of gonorrhoea. The bark has been used for tanning, although it only contains 3–6% tannin. *Afrocarpus falcatus* is planted as ornamental and roadside tree. It is very useful for soil protection against water erosion. It is also planted as windbreak.

Properties: The heartwood is pale yellow to pale yellowish brown, and not distinctly demarcated from the sapwood. The grain is straight, occasionally spirally, texture fine and even. Reddish

streaks of compression wood and darker lines resulting from year rings may be present. Resin is absent, and the wood has no distinctive odour.
The wood is moderately lightweight, with a density of 430–560 kg/m³ at 12% moisture content. It usually air dries without problems, but surface checking, splitting and distortion may occur; close stacking and heavy weighting are recommended. Kiln drying should be done at lower temperatures. The rates of shrinkage from green to oven dry are low. Once dry, the wood is stable in service.
The wood is easy to saw and work, both by machine and hand tools, and can be planed to a smooth finish. The wood has a tendency to split upon nailing, and pre-boring is recommended. The gluing, painting, varnishing and staining properties are moderately good. Steam bending gives moderate to satisfactory results. Turning gives good results. The peeling properties are good; good-quality veneer can be produced from the wood. The wood is not durable, but it is permeable to preservatives. The wood is resistant to acids.
Podolide, a norditerpene dilactone with in-vitro antileukemic properties, has been isolated from leaves of Afrocarpus falcatus. The tubulin-binding diterpene taxol has been isolated in small amounts from young stems and leaves.

Source: Aerts, R., 2008. *Afrocarpus falcatus* (Thunb.) C.N.Page. In: Louppe, D., Oteng-Amoako, A.A. & Brink, M. (Editors). Prota 7(1): Timbers/Bois d'œuvre 1. [CD-Rom]. PROTA, Wageningen, Netherlands.

***Albizia gummifera* (J.F.Gmel.) C.A.Sm**.
Vernacular names : Peacock flower, smooth-bark flat-crown

Albizia gummifera is widespread, occurring from eastern Nigeria to western Ethiopia and Kenya, and south to Zimbabwe and Mozambique; also in central Madagascar.

Description: Medium-sized deciduous tree up to 30 m tall; bole straight and cylindrical, up to 75(–100) cm in diameter, without buttresses or with small, thick buttresses; bark yellowish to grey, usually smooth, inner bark with clear gum; crown flattened; young branches finely pubescent, but soon glabrescent. Leaves alternate, bipinnately compound. Flowers bisexual, regular, white in lower part and reddish in upper part. Fruit an oblong, flat pod 10–21 cm × 2–4 cm, with stipe c. 1 cm long, glabrous, transversely veined, pale brown to reddish brown when ripe, opening with 2 papery valves, 9–12-seeded. Seeds flattened globose to broadly oblong, 8–12 mm × 7–10 mm.

Ecology: Albizia gummifera occurs in rainforest and riverine forest, sometimes also in savanna vegetation close to forest, usually at higher altitudes, up to 2500 m, but sometimes near sea-level. It is locally common. In Zimbabwe it is reportedly fire resistant and only slightly sensitive to frost.

Growth and development: Seeds for planting should be collected from the trees before the pods dehisce, to avoid insect damage. There are 10,000–15,000 seeds per kg. Fresh seeds may have a germination rate of up to 80% in 3–10 days, and do not require pre-treatment. Seeds can be stored for more than one year in a sealed container in a cool place, after adding ash to reduce insect damage. But seedcoat-induced dormancy has been recorded, hampering complete, rapid

and uniform germination. Scarification like soaking seeds in water improves the germination capacity. A fine and firm seedbed is required for even germination and vigorous seedling growth. The addition of NPK fertilizer is sometimes recommended for seedlings. Wildlings are sometimes collected for planting. Trees are capable of growing rapidly. In planting experiments in Ethiopia, Albizia gummifera showed a survival rate of 94%. Young planted trees can be managed by coppicing and lopping. They are often damaged by strong wind, from which they should be protected.
The roots develop nitrogen-fixing nodules containing Bradyrhizobium bacteria.

Uses: Treatment of the logs with preservatives is necessary if they are to be left in the forest for some time, to avoid damage by fungi or insects. The wood is used for light construction, furniture, cabinet work and various implements. It is also suitable for mine props, light flooring, joinery, interior trim, panelling, framing, toys and novelties, sporting goods, boxes, crates, carvings, peeled and sliced veneer, plywood, hardboard and particle board. Logs are traditionally used for the construction of canoes. The wood is sometimes used as firewood and for making charcoal. The wood pulp is suitable for paper production. The gum from the bark is sometimes used in confectionery.
Albizia gummifera is planted as an ornamental shade tree. It is a multipurpose species and is valued as a shade tree for crops, e.g. in coffee plantations in Ethiopia, tea plantations in Malawi and vanilla plantations in Madagascar, and is also planted or retained for soil conservation and improvement.
Albizia gummifera seems to have good prospects as a commercial timber tree in sustainably managed forests and in afforestation Projects. Further tests are needed to confirm its promise as an auxiliary tree in agroforestry systems. Once adequate vegetative propagation techniques have been developed, *Albizia gummifera* deserves to be promoted for planting.

Various plant parts are used in traditional medicine. In Kenya a bark infusion is taken to treat malaria, in Uganda to hasten parturition. The pounded bark is used in Kenya as a snuff to treat headache, and in Tanzania it is applied externally to treat scabies. In eastern DR Congo a bark maceration is used as a body wash and drink to treat psoriasis. The roots and leaves are purgative and are used in Madagascar to treat diarrhoea and eye troubles. In Malawi roots are soaked in water for 10 minutes, and the liquid is drunk to relieve the pain caused by sprains. In Madagascar a leaf decoction is reputed to have antitussive activity and is administered to treat asthma; leaves are applied to sores and fractures. In Kenya pounded roots are added to a bath to treat skin diseases, and an extract of crushed pods is drunk to treat stomach-ache. In Uganda roots are used to treat sleeping sickness.
The foliage is browsed by goats. The flowers produce nectar for bees, which often build nests in the trunk. The leaves are said to quicken the ripening of bananas.

Properties: The heartwood is yellowish brown or reddish brown, often with a golden tinge, and distinctly demarcated from the 7–10 cm wide pale yellow or white sapwood. The grain is straight or interlocked, texture medium to coarse. Quarter-sawn surfaces are often striped.
The wood properties of Albizia gummifera are variable and depend on the origin of the wood, that from Madagascar being heaviest and strongest. The wood is moderately light to moderately heavy, with a density of 430–800 kg/m³ at 12% moisture content. It dries slowly, but generally with little degrade. The shrinkage rates from green to oven dry are 2.9–3.5% radial and 8.2–8.7%

tangential. Once dry, the wood is fairly stable in service. At 12% moisture content, the modulus of rupture was 75 N/mm², modulus of elasticity 8900 N/mm², compression parallel to grain 40.5 N/mm², shear 12 N/mm², cleavage 82 N/mm and Janka side hardness 2840 N in a test of wood from Uganda.
The wood generally saws and works fairly easily with ordinary hand and machine tools, but sawn and planed surfaces tend to pick up. The use of a filler is necessary to obtain a good finish. The wood holds nails and screws well and does not split easily. The gluing and staining properties are satisfactory, and steam bending properties moderate. The wood dust may cause irritation to nose and throat.
Reports on durability of the heartwood are contradictory, but in general it is susceptible to fungal, wood borer and termite attack. The heartwood is resistant to impregnation by preservatives.
The wood is very similar to that of Albizia zygia (DC.) J.F.Macbr.
In an experiment in Ethiopia, the leaves and twigs of Albizia gummifera contained per 100 g dry matter: N 3.8 g, P 0.2 g, K 1.5 g, lignin 26 g, soluble polyphenols 8.5 g; they had a C/N ratio of 12. Mulching a maize crop with the leaves and twigs resulted in a smaller yield increase than green manure of the other species tested, probably due to the low P and K content of the Albizia gummifera green manure.
A dichloromethane extract of Albizia gummifera root bark showed considerable in-vitro antitrypanosomal activity, with an IC50 value of 0.07 µg/ml, which confirms its use as a traditional treatment of sleeping sickness. Extracts also showed in-vitro antimalarial activity against Plasmodium falciparum, although much less than chloroquine used as reference drug. The presence of triterpenoid saponins, sapogenin lactones and macrocyclic spermine alkaloids (budmunchiamines) has been reported for the stem bark. These last compounds were active against gram-positive and gram-negative bacteria.

Source: Maroyi, A., 2007. *Albizia gummifera* (J.F.Gmel.) C.A.Sm. In: Louppe, D., Oteng-Amoako, A.A. & Brink, M. (Editors). Prota 7(1): Timbers/Bois d'œuvre 1. [CD-Rom]. PROTA, Wageningen, Netherlands.

***Croton macrostachyus* Hochst. ex Delile**

Vernacular names: Woodland croton, forest fever tree, broad-leaved croton

Croton macrostachyus occurs throughout tropical Africa, including Madagascar.

Description: Monoecious or dioecious, deciduous, medium-sized tree up to 25(–30) m tall; bole cylindrical, up to 100 cm in diameter; bark grey to grey-brown, finely fissured and cracked, inner bark pale brown to reddish brown, smell peppery; crown rounded and open. Leaves alternate, simple; blade ovate-elliptical to almost circular, up to 17cm × 14cm, base cordate, apex acuminate, whitish green beneath. Inflorescence a slender, terminal raceme up to 35 cm long, either with only male or female flowers or male and female flowers variably mixed. Flowers unisexual, yellowish to white, fragrant. Fruit an almost globular capsule 8–12 mm in diameter, whitish to pale greyish brown, 3-seeded.

Ecology: Croton macrostachyus commonly grows in secondary forests, especially on forest edges and along rivers or lakes, in moist or dry evergreen upland forest, woodland, wooded grassland, bushland and along roadsides, often on soils of volcanic origin, at 200–2500(–3400) m altitude. The mean annual rainfall varies from 150 to 1200 mm.

Growth and development: In dry regions of West Africa flowering starts at the beginning of the rainy season. In Nigeria flowering occurs in March–May. In Kenya flowering occurs almost throughout the year with peaks in March–June in western Kenya and May–June in central Kenya. Pollination is done by insects. Fruit development takes 4–5 months.
The seeds are often damaged by insects while still on the tree. Fruits are sun-dried to release the seeds. The number of seeds per kg is 16, 000–27,000. The seeds retain their viability for several months if kept dry and free from insects at a maximum of 20°C, and for at least 2 years when dried below 8% humidity. Croton macrostachyus is propagated by seed or wildlings. Direct seeding is preferred, and pre-sowing treatment is not necessary. The seeds are sown in a mixture of sand and compost (1:2), covered lightly with fine compost and kept moist. They take 3–8 weeks to germinate. Under ideal conditions, 40–70% of the seeds germinate in 4 weeks. If planted in a nursery, transplanting should be done at the 2-leaf stage.
Croton macrostachyus can be lopped, pollarded or coppiced. It grows well both in shade and bright sunlight; it is vulnerable though to cold wind and frost, especially young plants, which should be protected during the first two years. *Croton macrostachyus* has a long taproot and numerous side-roots, which makes it adapted to dry climates. The maximum growth rate is about 1.5 m/year.
Croton macrostachyus has several other important uses, e.g. to control soil erosion, as a shade tree and for its green manure and fodder, which deserve additional tests in the field.

Uses: The wood is used in eastern and southern Africa to make tool handles, small stools, boxes, crates and plywood, as flooring and building material and in carpentry. The wood is used as fuel that burns even when green, but with a rather unpleasant spicy odour and much smoke; it is also used to make charcoal.
Croton macrostachyus is an important medicinal plant especially in East Africa. It is widely used: decoction, infusion or maceration of leaves, stem bark or root bark are taken as a purgative and vermifuge, but also to treat venereal diseases and to induce abortion. Leaf sap is used similarly. The seed oil is a very powerful purgative. All parts, but especially the seeds, are considered toxic, and any medicine made from them should be used with caution. Despite the many medicinal uses, not much research has been done concerning the chemical composition and pharmacology of the different plant parts and more research is warranted.
In Kenya *Croton macrostachyus* is commonly planted as a shade tree in villages and in coffee plantations. Due to its drought hardiness and fast growth, *Croton macrostachyus* is considered useful for afforestation of shifting sand dunes, degraded waste land, hill slopes, ravines and lateritic soils. It is also grown as a hedge plant and is suitable for intercropping. In Uganda sheep and goats do not browse young leaves, but old leaves are readily eaten. In Sudan the leaves are burnt to make vegetable salt. In Ethiopia the leaves are used as green manure and fodder. The fruits are very popular with birds and could be used as poultry feed. The flowers are heavily scented and give a dark-amber coloured honey with strong flavour. Croton macrostachyus is widely used in rituals.

Properties: The wood density is about 540 kg/m3 at 12% moisture content. The wood is moderately soft, perishable and susceptible to attack by woodborers. The wood is difficult to saw. In tests, sulphate pulping gave a pulp of moderate strength; the wood can be used to make writing paper or newsprint paper after bleaching, but it is unsuitable for the production of wrapping paper.
The seeds contain about 19% oil, which is a slightly viscous, yellow-orange fluid and slightly vesicant. The seeds also contain several saponins and a resin, which is said to be more toxic to insects than rotenone. The plant also contains the chalcone crotin. The stem bark and twigs contain lupeol, betulin and several fatty acids. The fruits contain crotepoxide, a cyclohexane diepoxide, which inhibits certain tumours in animal models. Aqueous and alcoholic stem bark extracts are toxic when injected intraperitoneally in mice. The crude ground seeds showed high molluscicidal activity in vitro.

Source: Mairura, F.S., 2007. *Croton macrostachyus* Hochst. ex Delile. [Internet] Record from Protabase. Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. < http://database.prota.org/search.htm>. Accessed 30 September 2009.

***Dombeya torrida* (J.F.Gmel.) Bamps**

Dombeya torrida is distributed from Eritrea and Ethiopia southward through Central and East Africa to southern Malawi; it also occurs in Yemen.

Description: Shrub or small to medium-sized tree up to 25 m tall; bole up to 120 cm in diameter, generally slightly curved or crooked; bark grey and smooth, slightly grooved with age, with lenticels; crown umbrella-shaped; young branches often red. Leaves alternate, simple; stipules; blade heart-shaped. Inflorescence an axillary umbel-like cyme many-flowered; flowers bisexual, regular, 5-merous; petals white or pink, with or without red centre or red veins, persistent and papery in fruit. Fruit an ovoid to globose, up to 10-seeded. Seeds ovoid-oblong, reddish brown to dark brown. Seedling with epigeal germination.

Ecology: Dombeya torrida occurs at 1600–3400 m altitude in forest, scrub, secondary bushland, grassland and cultivated land.

Growth and development: Dombeya torrida can be propagated by seed. There are about 235,000 seeds per kg. After drying the fruits in the sun for 2–3 days, the seeds are easily separated by rubbing or light threshing in a bag. Seed can be stored in airtight containers without seed treatment. The seed normally germinates in 15–20 days. Growth is fairly fast.
Seedlings are also collected from the wild.
Coppicing, lopping and pollarding of the tree are possible.

Uses: The wood of *Dombeya torrida* is suitable for construction, flooring, ship and boat building, vehicle bodies, furniture, handles, agricultural implements, poles and piles. Logs are carved into traditional stools. *Dombeya torrida* is also used as firewood and for making charcoal.

Fibre from the bark is made into rope, string and cloth. The flowers produce good nectar for bees. Fallen leaves improve the soil. In East Africa a decoction of the flowers and bark is taken against indigestion.

Properties: The heartwood of *Dombeya torrida* is not clearly demarcated from the sapwood. The wood is uniformly pale brown, often with a central core of dark brown wood with olive streaks. The grain is usually straight, texture fine to medium.
The density of the wood is about 705 kg/m³ at 12% moisture content. The wood is liable to checking in seasoning. It is strong and tough. The wood saws and planes well and nails without splitting, but it is not suitable for turnery.
The durability of the wood is low to moderate. The sapwood is susceptible to attack by termites, marine borers and Lyctus borers. The sapwood and heartwood are moderately resistant to impregnation.
The fine hairs on the fruit may cause eye irritation.

Source: Brink, M., 2007. Dombeya torrida (J.F.Gmel.) Bamps. In: Louppe, D., Oteng-Amoako, A.A. & Brink, M. (Editors). Prota 7(1): Timbers/Bois d'œuvre 1. [CD-Rom]. PROTA, Wageningen, Netherlands.

Ekebergia capensis

Uses: The wood is locally valued for furniture, light construction, poles and tool handles. It is suitable for light flooring, joinery, interior trim, ship building, boxes, crates, matches, turnery, veneer and plywood. It is also used as firewood and for charcoal production.
The bark, roots and leaves are widely used in traditional medicine. Bark decoctions, infusions and macerations are taken to treat gastritis, heartburn, dysentery, epilepsy, gonorrhoea and as vermifuge, and are applied externally to ulcers, abscesses, boils, scabies, acne, pimples and itching skin. A powder prepared with the bark is sniffed against headache, colds and sinusitis. A root decoction is taken as a diuretic and to treat kidney problems, dysentery, heartburn, headache and respiratory complaints. The root is chewed as an expectorant. Charred pulverized roots are sniffed for treatment of headache and blocked nose. Leaf macerations are used internally or externally to treat headache, fever, cough and skin complaints, and they are taken as a vermifuge. The wood is used by Zulu people to facilitate childbirth. Decoctions of various parts of *Ekebergia capensis* are used traditionally in central Ethiopia as an anthelmintic for the treatment of livestock. Bark and roots have been used as ordeal poisons.
In southern Africa the bark has been used for tanning.
The fruit is edible but usually not much liked. The foliage is browsed by livestock in the dry season. *Ekebergia capensis* is planted as an ornamental, particularly as a roadside tree, but also as a garden tree for its attractively coloured fruits and for shade. It is occasionally planted for soil conservation, as a windbreak and as a shade tree in coffee and banana plantations. The flowers are a source of nectar and pollen for honey bees.

Properties: Logs should be removed from the forest immediately after felling because they are very susceptible to blue stain and insect attacks. The wood should be treated with preservatives and anti-stain solution immediately after sawing.

The heartwood is whitish to pale pink when freshly cut, darkening to greyish white, pale pinkish brown or pale brown upon drying. It is indistinctly demarcated from the sapwood. The grain is straight, texture moderately fine to coarse. Some figure may be present on backsawn surfaces.
The wood is medium-weight to moderately heavy, with a density of 500–700 kg/m³ at 12% moisture content. It air dries rapidly and without serious degrade. Boards up to 25 mm thick can be air dried in less than one month and thin boards can be kiln dried in 6 days. The wood is moderately stable in service.
The wood is easy to saw and work with both hand and machine tools. It planes to a smooth surface and takes a fair polish. It has good nailing properties, but may split occasionally. Boring and mortising do not cause problems. The wood has good veneering and moulding properties. It is not durable and is susceptible to blue stain and insect attacks. The heartwood is moderately permeable for preservatives, the sapwood permeable.
The growth of both drug-resistant and drug-sensitive strains of *Mycobacterium tuberculosis* was inhibited by bark extracts of *Ekebergia capensis* at a concentration of 0.1 mg/ml. Bark extracts showed antiplasmodial activity against both chloroquine-sensitive and chloroquine-resistant strains of *Plasmodium falciparum* with IC50 values of less than 30 μg/ml. In-vivo tests in mice showed significant suppression of chloroquine-tolerant *Plasmodium berghei* by *Ekebergia capensis* bark and leaf extracts. Several antiplasmodial triterpenoids have been isolated from the bark. Methanol extracts of the bark showed pronounced antibacterial activity against several bacteria. The bark contains the toxic compound 8-methoxy 4-methyl coumarin. Tests on guinea-pig uterine smooth muscle showed uterotonic activity of wood extracts of *Ekebergia capensis*; the active compounds isolated were identified as oleanonic acid and 3-epioleanolic acid. Leaf extracts demonstrated antioxidant activity. Seed extracts showed significant in-vitro anthelmintic activity against *Haemonchus contortus*, supporting the traditional use as an anthelmintic for livestock in Ethiopia.
It has been reported that the bark contains about 7.2% tannin. Limonoids, terpenoids, flavonoids, steroids and phenolic compounds have been isolated from *Ekebergia capensis*. The seeds contain the limonoid ekebergin as main constituent.

***Hagenia abyssinica* (Bruce) J.F.Gmel**.

Vernacular names: Kosso, kousso.

Hagenia abyssinica is indigenous to montane regions of eastern, central and southern Africa, mostly above 2000 m altitude. It is found in the Democratic Republic of Congo, Sudan and Ethiopia, and south to Malawi, Zambia and Zimbabwe.

Description: dioecious, small to medium-sized tree, up to 20 m tall; bole rarely straight, up to 60(–220) cm in diameter; bark pale red-brown, flaky; crown wide, umbrella-shaped; young branches densely covered with short, villous hairs and long, erect, silvery, soft, often glandular hairs turning reddish-green, with ring-like, long persisting leaf scars. Leaves alternate, imparipinnate, up to 50 cm long; petiole up to 15 cm long, with 2, up to 1.5 cm wide, thin, leafy lateral wings (adnate stipules) at base surrounding the twig as a sheath; leaflets up to 17, alternate to subopposite, subsessile, narrowly oblong to elliptical, 9–15 cm × 2–5 cm, obliquely obtuse at base, acuminate at apex, margin serrate and long silky hairy, the teeth usually ending in a thickened gland, pinnately veined with veins prominent below and having long silky hairs;

much smaller, suborbicular leaflets up to 2.5 cm in diameter may occur alternating with the normal leaflets. Inflorescence a terminal, drooping, much-branched, many-flowered panicle up to 60 cm × 30 cm, yellowish, often bright red tinged; branches villous to long silky hairy, sticky, subtended by leafy bracts, rachis usually zigzag. Flowers unisexual, regular; pedicel up to 3.5 mm long, densely hairy, subtending bracts clasping the pedicel at base, bracteoles reniform; hypanthium a conical, silky hairy tube 2–3 mm long, with 2 whorls of (4–)5 green or reddish tinged lobes (epicalyx and calyx), in male flowers epicalyx lobes smaller than calyx lobes, in female flowers larger and enlarging up to 10 mm long in fruit; petals (4–)5, vestigial, up to 1.5 mm long, alternating with the calyx lobes; stamens 15–20, filaments up to 3 mm long in male flowers, in female flowers rudimentary; pistils usually 2, free within the hypanthium, ovary with a tuft of hairs at top, style subfiliform, stigma capitate, usually only one ovary per female flower developing to fruit, in male flowers functionally sterile. Fruit a globose to ovoid achene up to 2.5 mm in diameter, with a thin, papery, pale to brown pericarp, white-hairy at top, enclosed by the dry persistent hypanthium with the epicalyx serving as wings. Seed subglobose to subovoid, only slightly smaller than the fruit, usually with a wrinkled, brown, glabrous testa.

Ecology: Hagenia abyssinica occurs in montane rain forest and evergreen bushland, at altitudes of 2000–4300 m where annual rainfall ranges between 1000-1600 mm. On Mt. Kenya, it is dominant in the zone above bamboo thickets, between 2900–3400 m, where it occurs in association with *Hypericum revolutum* Vahl, *Juniperus procera* Hochst. ex Endl. and *Gnidia glauca* (Fresen.) Gilg. At these altitudes forest fires are rare, but occasional severe fires can occur during drought. In Ethiopia, *Hagenia abyssinica* is a dominant tree in subhumid montane woodland (rainfall up to 1250 mm per year). In humid montane woodland (rainfall up to 1600 mm per year), it occurs in association with the dominant tree bamboo *Sinarundinaria alpina* (K.Schum.) C.S.Chao & Renvoize, together with *Schefflera volkensii* (Engl.) Harms, *Hypericum* spp., *Ilex mitis* (L.) Radlk. and *Nuxia congesta* R.Br. ex Fresen.

Growth and development: Individual trees are either male or female, but sometimes polygamous. In Ethiopia, flowering occurs during the dry season between October and February; on sunny days the flowers are much visited by bees.

Seed can be stored dry without special requirements for 0.5–1 year. Germination is about 40-60% after 2–3 weeks from sowing. The seed is very light: 400–500 seeds per gram.
In the forest, individual *Hagenia abyssinica* trees often belong to the same or only a few size classes and are presumably the same age. It has been assumed that *Hagenia abyssinica* has a regeneration cycle associated with heavy forest fires that are crucial by clearing the area of competitive plants and heating the prospective seedbed. Mature *Hagenia abyssinica* trees are tolerant of fire, and heavy fires create ideal germination conditions for the small wind-dispersed seeds. *Hagenia abyssinica* is unable to regenerate in areas suffering from a high level of grazing. Young trees have poor competitive ability. In locations with high population and cattle pressure the species is now rare or has disappeared (often cut for firewood purposes).
The tree is occasionally planted around churches and villages. Large-scale cultivation is unknown. In agricultural areas, *Hagenia abyssinica* can be found scattered in fields because it is not usually cut down. In agroforestry systems in the southern highlands of Tanzania, trees grown or retained for shade are pruned once a year, about 50% of the foliage being removed.

No germplasm collections are known. Living collections and other conservation measures are strongly recommended.

Uses: The wood has a handsome appearance and is suitable for furniture, cabinet work, floors, veneers, tools and fences; the wood is used as fuel.
Throughout history, *Hagenia abyssinica* has been used as an anthelmintic in Ethiopia and other parts of Africa. Almost every Ethiopian used to drink an extraction of dried flowers once every 1-3 months to expel tapeworm, which was, and to some extent still is, a common parasite in Ethiopia where raw meat, a source of infection, is a delicacy and a very popular item in the diet. It became known to European medicine as a tapeworm remedy early in the 19th century. Honey, obtained from beehives located near *Hagenia abyssinica* trees and collected immediately after their flowering, is also said to be effective in expelling tapeworms. In the 19th century, kosso was widely used as an anthelmintic in Europe. It is also used, often in a mixture with parts of other plants, as a medicine to treat syphilis, scrofula, malaria, fever and cough. *Hagenia abyssinica* has strands of red flowers, giving the tree ornamental value.
In Tanzania, *Hagenia abyssinica* is grown in agroforestry systems, the leaves are used as fodder and green manure, and the seeds as a condiment or spice. In the Kilimanjaro area, the bark is used for dyeing textiles yellowish red.

Properties: The sapwood is creamy-yellow; the heartwood dark red to red-brown, soft and moderately heavy (560–750 kg/m³ at 12% moisture content). The wood is usually straight-grained with occasionally some silver grain when cut radially. Kosso wood is not durable, and is subject to attack by borers and termites. Distortion during air drying may be severe. Average shrinkage from green to 12% moisture content is low. The wood is fairly easy to saw. Planing may be difficult due to interlocked grain, but the moulding, boring and turning are satisfactory. Pre-boring before screwing is essential. Nail-holding power is high. The heartwood is very resistant to impregnation.
Kosso is an anthelmintic and also acts as a muscle poison in some small animals. The active principles in *Hagenia abyssinica* flowers are phloroglucinol derivatives.
Several plant species were used in Ethiopia to combat tapeworm infection, but kosso became the most popular and it became customary for people to have ‘a kosso day’ every 1–3 months. The extract is drunk before breakfast; about 0.5–3 hours later its laxative action starts. The head of the tapeworm (scolex) is seldom expelled, so the worm can regrow, hence the need to repeat the treatment every 1–3 months.
The efficacy of kosso as anthelmintic depends on dosage and the health of the patient. Strong doses of kosso can cause fainting, visual disorders or even death. Health organizations currently discourage the use of kosso because the dosage of the active principle cannot be controlled by using the flower extract. Adulterations and substitutes
Finely powdered kosso can easily be adulterated by any other brownish powder, whereas intact flower parts are very distinctive and cannot be adulterated. In Ethiopia, there are many plants with anthelmintic activity; fruits of Embelia schimperi Vatke (‘enkoko’) are most often used here as a substitute for kosso.

Source: Jansen, P.C.M. & Getachew Aweke, 2002. *Hagenia abyssinica* (Bruce) J.F.Gmel. [Internet] Record from Protabase. Oyen, L.P.A. & Lemmens, R.H.M.J. (Editors). PROTA (Plant

Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. < http://database.prota.org/search.htm>. Accessed 30 September 2009.

***Juniperus procera* Hochst. ex Endl**.

Vernacular names: African pencil cedar, East African cedar, East African juniper, pencil cedar).

Juniperus procera occurs wild from Sudan, Eritrea and Ethiopia southwards through East Africa and eastern DR Congo to Malawi and Zimbabwe; it also occurs wild in Saudi Arabia and Yemen.

Description: Large, evergreen, usually dioecious tree up to 40(–50) m tall; bole branchless for up to 20 m, straight, tapered, up to 200(–300) cm in diameter, often fluted; outer bark fissured, exfoliating in long narrow papery strips, pale brown weathering grey-brown; crown pyramidal in young trees, wide-spreading and flat-topped in older ones; branches spreading or ascending. Leaves decussately opposite, simple, scale-like, yellowish green to pale green. Male cone terminal, solitary, globose to ovoid, orange-brown when mature. Female cone terminal on short erect branchlets, mature one berry-like, globose, brown, blue or purplish black. Seeds angular-ovoid, yellowish brown.

Ecology: Juniperus procera is a highland species and prefers cold high ridges. It is commonly found between 1800 m and 2800 m altitude, but occurs in a broader range of 1000–3500 m, with an average annual temperature range from 5°C to 20°C. Average annual rainfall in the forest belt with much *Juniperus procera* is 1000–1400 mm, but the tree can grow in a wide range of rainfall zones (300–2000 mm/year). Individual trees can survive in hot and dry conditions, once established, but in areas with low rainfall, the trees are generally of poor form and small size. Where rainfall exceeds 1400 mm/year, the forests dominated by *Juniperus procera* are gradually replaced by moister types of evergreen forest in which *Juniperus procera* becomes increasingly rare. *Juniperus procera* prefers rocky soils, with a light to medium texture and free drainage.
Juniperus procera is a characteristic tree of the undifferentiated and dry Afromontane forest types, but can also occur in forests transitional between dry Afromontane forest and semi-evergreen bushland and thicket. The understorey of *Juniperus procera* forest is usually a dense, evergreen mix of shrubs and herbaceous plants. The trees are sometimes covered with mosses and lichens. Climbers are common (the large liana *Toddalia asiatica* (L.) Lam. is very frequent) and epiphytic figs are occasionally found. *Juniperus procera* is a prolific seed-bearer and the seeds, though sometimes damaged by seed-boring insects, are usually fertile. However, no regeneration is observed in mature juniper forests as young seedlings are very light demanding and absolutely intolerant of any decomposing organic matter covering the ground. Therefore the seeds can only germinate freely in open, grassed areas or among shrubs, such as in glades or forest edges, with adequate light and mineral soils. Consequently, *Juniperus procera* forests can only develop in two principal ways: either saplings are found growing under the shelter of bushes at forest edges, or natural regeneration occurs after a fire or in large clearings of other origin, giving rise to usually very dense, even-aged stands of trees with long, branch-free boles. Due to these strict requirements, artificial regeneration appears to be the easiest and fastest way to maintain *Juniperus procera* forests.

Growth and development: Juniperus procera has irregular flowering and fruiting periods, only flowering once every several years. It is wind pollinated and seeds are dispersed by birds.
Juniperus procera is easily propagated by seed. The 1000-seed weight is 20–30 g. Seeds can be obtained by collecting seed cones from the tree, spreading them on a floor to dry, crushing them with mortar and pestle, and separating the seeds by sieving and winnowing. The seed stores well. The optimum temperature for germination is around 20°C; germination is better in light than in the dark. The germination rate in nurseries is usually 40% after 6 weeks, but considerable variation has been. Germination can be enhanced by pre-treatment with hot water, concentrated sulphuric acid or scorching. Seedlings are ready to be planted out when 1–2 years old and 15–25 cm tall. Wildlings are also used for planting. Under conditions in which Juniperus procera readily regenerates, stand establishment by direct sowing may even be applicable.Relatively dense spacing is required, preferably 1.2–2 m × 1.2–2 m, to promote self-pruning in the extremely branchy thicket-stage.
Vegetative propagation of Juniperus procera is possible: stecklings (rooted cuttings) with well-developed root systems easily establish and grow well. In experiments, rooting was best in cuttings from young plants (5 months old), but somewhat older plants (10–15 months) yield more cuttings. Rooting in cuttings from mature trees is poor.
In plantations, weeding should be done during the rainy season at least once a year during the early growth stages. Litter fallen from the tree makes the soil acidic, so *Juniperus procera* should not be intercropped with crops. Pruning is an important management operation which can significantly increase the timber production of a stand, although the presence of wounds in which the heartwood is exposed increases the risk of damage by the wood-rot fungus *Fomes juniperinus*. Pruning should start 3–6 years after planting. Early selective thinning, starting in the 5th year, is also recommended to enhance crown development and diameter growth.
Growth of Juniperus procera is slow. In Ethiopia 10–15-year-old plantation trees were 6–9 m tall, with a bole diameter of 8–16 cm, whereas 30–40-year-old plantation trees were 17–21 m tall, with a bole diameter of 16–29 cm. In a 200-year-old stand, the trees were 37.5 m tall, with a bole diameter of 107 cm. In the Usambara mountains in Tanzania (altitude 1450 m, average annual temperature 18°C, average annual rainfall 1070 mm) 61-year-old Juniperus procera trees in a density of 182 trees/ha had an average height of 32.5 m and an average bole diameter of 47 cm. The standing volume was 247 m³ per ha. A naturally regenerated 15-year-old stand in Kenya, result of an earlier fire, had an average tree height of 14.7 m and an average bole diameter of 23 cm; 35 years later the trees in this stand (density 262 stems/ha) had an average height of 23.5 m and an average bole diameter of 39 cm. In a 41-year-old plantation in Burundi, trees had an average height of 24 m and an average bole diameter of 29.5 cm (range 19–50 cm). The growth of plantations ranges from 3.5 to 13 m³/ha/year, averaging 7.5 m³/ha/year; so the production of suitable logs for the sawn wood and veneer market may be possible with a rotation period of 70–100 years.

Juniperus procera is assumed to be deep-rooting, like other Juniperus spp., but the characteristics of its root system are poorly known.

Diseases and pests: *Juniperus procera* is subject to serious attacks by the wood-rot fungus *Fomes juniperinus*. The fungus creates cavities of various sizes, and in the case of serious infestation a large tree may be reduced to a mere shell. Mature trees or trees growing in humid locations almost always contain at least some heart rot. The fungus cannot survive in dead trees. Measures

to reduce damage by *Fomes juniperinus* include strict protection from fire and other injury, maintenance of dense stands to favour natural pruning while trees are still young (before heartwood formation), periodical thinning of all stems with broken branches or wounds in which the heartwood is exposed, and removal of stems already attacked by the fungus. The tree is also affected by *Rhynchosphaeria cupressi*, causing stem and branch canker.
Juniperus procera is damaged by the cypress aphid (Cinara cupressi), but not as severely as *Cupressus lusitanica* Mill.

Genetic resources: In spite of its wide distribution, *Juniperus procera* is mentioned in the 2006 IUCN Red list of threatened species, although in the lower risk category. Overexploitation, changing land use patterns, browsing (particularly by buffalo and elephants) and the increasing populations of fast-growing exotic species are contributing to the decline of Juniperus procera..

Uses: The wood of *Juniperus procera* (trade name: African pencil cedar) is widely used for building (both construction and lining), joinery, flooring (strip and parquet), furniture and all sorts of outdoor work such as roofing shingles, fence posts, water flumes and transmission poles. In Kenya the wood is also used for making fire sticks, beehives and salt-troughs. Juniperus procera wood was exported to Europe and North America for the manufacture of pencils and penholders, while small quantities were used for wardrobe linings. It is also suitable for musical instruments, carving, turnery, food containers, veneer and plywood, hardboard and particle board, and as pulpwood. The wood is used as firewood and to make charcoal.
The bark is used for roof shingles and for covering beehives.
Essential oil distilled mainly from the sawdust ('cedar wood oil', 'cedar oil') is used in the cosmetic industry in soaps and perfumes. Since *Juniperus procera* can grow in extreme conditions, it is replanted in deforested areas for soil conservation or improvement and for erosion control, e.g. in Eritrea, Ethiopia and Kenya. It is also a useful shade tree, and is frequently planted as an ornamental tree and in windbreaks.
In traditional African medicine, an infusion of ground young twigs is taken against intestinal worms. People with rheumatism are treated by exposure to the smoke of burnt twigs and seed cones. The smoke is also inhaled as an expectorant. Ground dried leaves are applied on wounds of humans and animals. A hot bath to which the leaves are added is used in the treatment of fever. The resin is used as a stimulant and applied to ulcers. Bark macerations are drunk and applied as a vaginal wash as birth-control agents. A decoction of the seed cones is used as a sudorific and emmenagogue. In veterinary medicine, chopped and finely ground leaves mixed with water are used as a drench for horses and mules with stomach disorders, whereas a decoction of dry young branches is a medicine against itch of camels.
Juniperus procera has ceremonial and religious significance, as in some parts of Ethiopia, where it is used especially in September during the traditional orthodox ceremony of Meskel.
There was formerly considerable overseas trade in African pencil cedar. Cedar wood oil has also been exported.

Properties: The heartwood is pale red, yellow-brown or purple-red when freshly cut, turning reddish brown on exposure; it is well demarcated from the cream-coloured or white sapwood, which is up to 2.5 cm wide in mature trees. The grain is usually straight, texture fine and even. The wood is very fragrant, with a characteristic and persistent aromatic cedar smell. Ingrown bark, spiral grain and compression wood are common defects. The wood is liable to bleach in the

sun and is sometimes streaked with zones of darker and lighter colour which produce an attractive figure.
The wood is medium-weight, with a density of 510–670 kg/m³ at 12% moisture content. It seasons well when dried with care, but larger pieces are liable to end-splitting and surface-checking, and the wood should not be allowed to dry rapidly in the initial stages. Kiln drying is preferable. The rates of shrinkage are low and the wood is very stable in service.
The wood is easy to work with hand and machine tools, although it is rather brittle and fissile, tending to break and chip on drilling and mortising. It can split on nailing and screwing, and pre-boring is necessary. The wood glues, stains and polishes well.
The durability is high, also in the ground. The heartwood is resistant to fungi, termites and most borers except *Oemida gahani*. The sapwood is not susceptible to attack by Lyctus beetles. The heartwood is impermeable to preservatives, and only thin material can be sufficiently impregnated; the sapwood, however, is permeable. The properties of the wood of African pencil cedar are quite similar to those of 'podo' (*Afrocarpus* and *Podocarpus* spp.).
The wood burns evenly when fresh, but fast, and the charcoal does not last long. The wood contains 0.5–3% essential oil, with as most important component cedrol (23–79%). Cedrol is known to have antitermite effects. Essential oil from the leaves has shown antioxidant activity. The leaves and bark contain diterpenes with antibacterial activity. The butanol fraction of an ethanol extract of the bark has shown anti-implantation activity in rats. The bark contains about 3.5% tannin.

Source: Couralet, C. & Bakamwesiga, H., 2007. *Juniperus procera* Hochst. ex Endl. In: Louppe, D., Oteng-Amoako, A.A. & Brink, M. (Editors). Prota 7(1): Timbers/Bois d'œuvre 1. [CD-Rom]. PROTA, Wageningen, Netherlands.

***Podocarpus latifolius* (Thunb.) R.Br. ex Mirb**.

Vernacular names: Podo, Real yellowwood, East African yellowwood, broad-leaved yellowwood, red-fruited podo

Podocarpus latifolius occurs in mountain forest from southern Sudan through eastern Central Africa and East Africa to Zimbabwe, Mozambique, Swaziland and eastern and southern South Africa, where it descends to sea-level. It is also found in the highlands of south-eastern Nigeria and western Cameroon, and has been recorded from an inselberg in Equatorial Guinea.

Description: Evergreen, dioecious, medium-sized to fairly large tree up to 35(–40) m tall, at high altitudes a shrub or small, stunted tree; bole branchless for up to 10(–20) m, usually straight and cylindrical, up to 150(–300) cm in diameter, sometimes with buttresses at base; bark surface greyish brown to dark grey, rather smooth, flaking in long strips, or longitudinally fissured, inner bark pale pink; twigs grooved by decurrent leaf bases. Leaves arranged spirally to nearly opposite, simple and entire, linear-elliptical, up to 10cm long. Male cone axillary, generally, pinkish to reddish; female cone terminal, solitary, glaucous green turning pink to reddish purple or blackish purple. Seeds drupe-like enclosed in a leathery integument.

Ecology: In East Africa *Podocarpus latifolius* occurs in forest in the mountains at 900–3200(–3500) m altitude. It prefers an annual rainfall of 1000–2000 mm and a mean annual temperature

of 9–19°C. It is often dominant at higher altitudes in more humid localities, preferring sites with higher annual rainfall than *Afrocarpus falcatus. Podocarpus latifolius* may be dominant in the climax vegetation of the lower and middle part of the montane zone, together with *Olea* spp. Locally it occurs in nearly pure stands, especially above 2600 m altitude, and it can also be associated with bamboo. In southern Africa it can be found from sea-level to mountain forest up to 2300 m altitude. *Podocarpus latifolius* is susceptible to drought. It tolerates light frost, but young seedlings are susceptible. It is characterized as a medium shade-tolerant species. It performs best on well-drained, deep, fertile soils. In cultivation it benefits from a layer of mulch on the ground. Natural regeneration of *Podocarpus latifolius* is abundant, especially in small and medium-sized gaps in the forest.

Growth and development: The 1000-seed weight is 360–600 g. Seeds are commonly attacked by insects, which may cause considerable losses. The fleshy receptacle should be removed from the seed. Seeds can be stored in a cold store for up to 1 year without losing much of their germination capacity, but moisture loss should be avoided. Fresh seeds should be cleaned and sown within 4 days. They germinate in 1–2 months, and the germination rate is up to 80%. Cracking of the seed coat has been recommended to speed up germination. When transplanting, care should be taken not to damage the taproot. The seedlings should be well watered. It is recommended to plant in shade and not in the full light, but in a test in South Africa seedlings grown without shade showed the best growth. Wildlings are sometimes also collected for planting.

Growth of *Podocarpus latifolius* is slow under natural conditions; for trees with bole diameters between 10 cm and 90 cm, mean diameter increment is 0.2–0.3 cm/year. In cultivation the growth rates are usually also quite low, but they depend on soil fertility and available water. For 32-year-old trees in Rwanda a height growth of 30–56 cm/year has been recorded, and a diameter growth of 4–13 mm/year.
Young trees up to pole size can be coppiced. In larger trees branches become drooping, and some pruning is often practised. In natural forest in the southern Cape region of South Africa, trees are selectively harvested under a felling cycle of 10 years, and selected according to externally visible criteria of maturity.
Trees 8–10 m tall may already fruit. In Kenya the fruiting period is in March–April. Monkeys and birds such as hornbills and turacos feed on the fleshy receptacle at the base of the seed, and they usually discard the seed undamaged, serving in this way as dispersers. However, most seed does not get far from the mother tree. Bushpig eat receptacles and seeds after falling. However, it has been reported that seed that has passed the digestive tract of bushpig has a very low germination rate, 2% in comparison with 70% in control seeds. Bee nests are often found in hollow *Podocarpus latifolius* trees. At higher altitudes, above 2600 m, the trees are usually stunted and rarely taller than 10 m.
Logs are susceptible to insect and fungal attacks and should be removed from the forest and converted as soon as possible after felling, or treated with preservatives. Dipping in an anti-sapstain solution immediately after conversion and before stacking is needed to prevent discoloration by blue stain.

Podocarpus latifolius is widespread and in many regions within its distribution area quite common. However, it has been subject for many decades to large-scale felling and larger trees

have become uncommon. It is included in the IUCN Red list, although still considered to be at lower risk.

Podocarpus latifolius provides a highly valued timber and as such deserves more research attention.

Uses: The wood is highly valued for furniture and ship building, e.g. for masts and planks, but it is also used for poles, panelling, boxes, veneer and plywood. It is suitable for construction, flooring, joinery, railway sleepers, musical instruments, food containers, carving, turnery, hardboard and particle board. It is also used as fuelwood, and it is considered a high-quality pulpwood.
People occasionally eat the fleshy receptacles at the base of the seeds. In Kenya a bark infusion is taken to treat stomach-ache. In Uganda a leaf decoction is taken as vermifuge. In the Mau region in Kenya the bark is used as waterproof cover for bee-hives. Podocarpus latifolius is planted as ornamental and roadside tree and also as shade tree in coffee, cocoa and banana plantations. It is the national tree of South Africa.
In the past, the wood of *Podocarpus latifolius* was in high demand in southern Africa, especially for flooring, furniture and it was harvested on a large scale. At present, the international trade in *Podocarpus latifolius* timber is very limited. In many countries illegal logging of this valuable timber species continues.

Properties: The heartwood is pale yellowish brown, and not demarcated from the sapwood. The grain is straight, occasionally spirally, texture fine and even. Reddish streaks of compression wood may be present. Resin is absent, and the wood has no distinctive odour. The wood closely resembles that of *Afrocarpus falcatus* (Thunb.) C.N.Page
The wood is moderately lightweight, with a density of 460–560 kg/m³ at 12% moisture content. It usually air dries without problems, but distortion, end splitting and checking may occur; close stacking and heavy weighting are recommended. Kiln drying should be done at lower temperatures. It has been recommended to air dry for 4–5 weeks, followed by 5–6 days of kiln drying to obtain optimal results. The rates of shrinkage from green to oven dry are low. Once dry, the wood is stable in service.
The wood is easy to saw and work with machine and hand tools. It can be planed to a smooth finish. The wood has a tendency to split upon nailing, and pre-boring is recommended; it holds screws well. It requires support in drilling and mortising because of its brittleness. The gluing, painting, varnishing and staining properties are moderately good. The peeling and slicing properties are good but veneer is brittle. The wood is not durable and is permeable to preservatives. The wood is resistant to acids.
Several cytotoxic norditerpene dilactones have been isolated from the bark, while the lactone inumakilactone B has been isolated from the wood, and heveaflavone, amentoflavone and derivatives from the leaves.

Source: Okeyo, J.M., 2008. *Podocarpus latifolius* (Thunb.) R.Br. ex Mirb. In: Louppe, D., Oteng-Amoako, A.A. & Brink, M. (Editors). Prota 7(1): Timbers/Bois d'œuvre 1. [CD-Rom]. PROTA, Wageningen, Netherlands.

***Syzygium guineense* (Willd.) DC.**

Vernacular names: Water berry, water pear, snake bean tree

Syzygium guineense is one of the most widely distributed African trees, occurring from Senegal eastward to Somalia and southward to Namibia, Botswana and South Africa. It also occurs in Saudi Arabia and Yemen.

Description: Evergreen shrub or small to medium-sized tree up to 30(–40) m tall; bole branchless for up to 15 m, seldom of good shape, up to 150(–200) cm in diameter, sometimes with buttresses up to 1.8 m tall; bark surface smooth or with small rectangular flakes, grey or dark brown to almost black, inner bark pale brown to dark red-brown, sometimes with pink tinge or streaks; crown rounded and heavy. Leaves opposite, simple and entire; blade elliptical, cuneate at base, obtuse to acuminate at apex, leathery, shiny dark green above, pale green below, fragrant when crushed. Inflorescence a terminal cyme, many-flowered. Flowers bisexual, white, fragrant. Fruit a globose to ellipsoid berry, red to purplish black. Seed rounded, yellowish to brownish.

Ecology: Syzygium guineense occurs up to 2700 m altitude, in areas with an average temperature of 10–30°C and an average annual rainfall of 700–2300 mm. It is found in a wide range of vegetation types, including rainforest, montane forest, riverine forest and woodland. It prefers moist, well-drained soils with a high water table. The presence of the tree is considered a fairly good indication that the groundwater table is near the surface.

Growth and development: Pollination is by insects. Natural regeneration is adequate in natural forest. Propagation by seed is easy and is the commonly used method of propagation. Ripe fruits are generally picked from the tree. If fallen, they must be picked immediately from the ground so that they do not spoil.The 1000-seed weight is 270–420 g. The seeds must be sown immediately after the fruits are picked, as they may spoil within 24 hours of storage. Germination is usually very good and uniform, and pretreatment of the seed is not necessary. Germination takes 20–30 days, with a germination rate of 80–90%. Seeds can be sown directly in the field or are sown in pots in a nursery. Wildlings can also be used for planting. Stem cuttings root easily, and grafting has been tested with a success rate of 50%.
The tree tolerates pollarding and is able to coppice.

Uses: The wood is used for construction, flooring, panelling, furniture, utensils, tool handles, plates, stools, carvings and poles. Its flexibility makes it suitable for bows and ribs of canoes. The bole is made into dugout canoes. In East Africa the wood has been used for railway sleepers. It is also suitable for vehicle bodies, interior trim, joinery, mine props, veneer, plywood, hardboard and particle board. It is good fuelwood and used for charcoal making.
The fruit is edible. It has been described as sweet and juicy, but also as having a rather bland taste and not being appreciated. It is sought after especially by children, and in Ethiopia and Kenya the fruit is sold on markets. The fruit is made into a beverage, vinegar and added to spirits for flavouring. In Sudan a meal is made from roasted and ground fruits. The bark is used for tanning and dyeing. Bark extracts are sometimes used to harden lateritic floors or to glaze

pottery. The leaves and fruits are used as fodder for livestock, and the flowers are a source of nectar for honey bees. The tree is used as a shade tree in coffee cultivation in Ethiopia.
Syzygium guineense finds wide application in African traditional medicine, but can be dangerous, as the bark may be poisonous, and death after its use has been recorded. The root is soaked in water for drinking and bathing to treat epilepsy. A root infusion is drunk for treatment of stomach-ache. Root extracts are taken as a purgative, anthelmintic and taeniacide. Bark decoctions are used against stomach-ache, diarrhoea and malaria; they are considered mildly laxative, and are applied in draught or in baths as a tonic. An infusion is taken against coughs, asthma, throat problems and intercostal pain. The powdered bark is used as an antispasmodic, purgative and anthelmintic, and used for treatment of diarrhoea, stomach-ache, broken bones and wounds. In Cameroon the bark is used for the treatment of snakebites. Twig bark preparations are applied against paralysis. A decoction of twigs and leaves is drunk or used as an enema for its purgative properties and against colic, diarrhoea and abdominal pain. It is also used as drink or bath against insanity, amenorrhoea and cerebral malaria. The crushed leaf is applied on wounds and boils, and taken to treat insanity and possession. Leaf decoctions are taken against intestinal parasites and stomach-ache, used as an enema against diarrhoea, and used as an embrocation to bathe and then massage into areas of sprain. Leaf decoctions or pulverized leaves are given as tonic to pregnant women. The leaf is chewed against stomach-ache. A liquid of chewed leaves mixed with water is used as eye drops to treat ophthalmia. The fruit is used for treating dysentery.

Properties: The heartwood is greyish red, brown or pink; it is not clearly demarcated from the 3–4 cm wide sapwood. The grain is straight, texture fine to medium. Growth rings are distinct. The wood is moderately heavy, with a density of 640–860 kg/m³ at 12% moisture content. Drying is slow, with moderate to severe distortion and splitting. In Tanzania boards of 2.5 cm thick air dry in 4 months and boards of 5 cm thick in 7 months. Kiln drying should be carried out at low temperatures; it gives a pronounced risk of distortion, and checking and splitting are fairly common. The rates of shrinkage from green to oven dry are hig. Movement in service can be large.
The wood is strong. It saws easily, but sawdust tends to adhere to the blades when the wood is fresh. It works easily with machine and hand tools, but is liable to splitting. It planes easily. Pre-boring is necessary for nailing; nail-holding properties are good. Moulding properties are good, and the wood bores and mortises well, when done with care. The wood is frequently recorded as non-durable. The heartwood is extremely resistant to impregnation with preservatives, the sapwood is permeable.
Fruits collected in Malawi contained per 100 g dry matter: energy 1096 kJ (262 kcal), crude protein 10.1 g, fat 4.0 g, carbohydrate 48.5 g, fibre 30.3 g, Ca 23 mg, Mg 225 mg, P 30 mg, Fe 76 mg. They also contain ascorbic acid.
Extracts of the stem bark, leaves and seeds have shown antibacterial and antifungal activity, and methanol extracts of the stem bark molluscicidal activity. Triterpenes with antibacterial activity against Escherichia coli, Bacillus subtilis and Shigella sonnei were isolated from a methanol leaf extract, the most active being arjunolic acid and asiatic acid.

Source:Maroyi, A., 2008. *Syzygium guineense* (Willd.) DC. [Internet] Record from Protabase. Louppe, D., Oteng-Amoako, A.A. & Brink, M. (Editors). PROTA (Plant Resources of Tropical

Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. < http://database.prota.org/search.htm>. Accessed 30 September 2009.

***Vitex fischeri* Gürke**
Synonym: *Vitex keniensis* Turrill (Meru oak, Kenya oak).

Vitex keniensis Turrill is often considered to represent a separate species, distinguished from *Vitex fischeri* by its larger tree size, and because it occurs mainly in montane rainforest.
These populations in montane rainforest in central Kenya, referred to as *Vitex keniensis*, where the boles are often straight and reach large dimensions and are thus of high value in the timber trade, have been overexploited and are classified as vulnerable in the 2006 IUCN Red list.

Description: Deciduous small to fairly large tree up to 35 m tall; bole branchless for up to 18 m, up to 180(–230) cm in diameter; bark very thin, bark surface grey to dark brown, smooth to rough and slightly fissured, inner bark creamy yellow to pale brown; crown rounded; young branches densely velvety hairy. Leaves opposite, digitately compound with 5 leaflets.

Ecology: Vitex fischeri occurs in evergreen forest, open woodland, wooded grassland and thickets, up to 2100 m altitude. In Kenya the mean annual temperature in the distribution area of Vitex fischeri is 15–23°C, and mean annual rainfall 1200–2000 mm. On the slopes of Mount Kenya it prefers deep sandy loam soils, but it is elsewhere locally common in thickets on granite rocks and in wooded grassland on termite mounds. In montane rainforest in central Kenya, natural regeneration of Vitex fischeri occurs particularly in forest gaps, and is poor in closed forest.

Growth and development: In Kenya trees flower from December to March, before the long rainy season starts in April. The flowers are pollinated by insects such as bees. However, fruits can be produced by both self- and cross-pollination. In Kenya ripe fruits can be found from June to November, and fruit maturity coincides with leaf fall. The seeds are dispersed by animals such as monkeys and hornbills that eat the fruits. Seedlings have simple leaves in the early stages and start to produce compound leaves after about 3 months.
Vitex fischeri trees grow moderately fast. In a plantation in Kenya, trees were on average 35 m tall 56 years after planting. Maximum mean annual volume increment was reached 25–30 years after planting, and a marked decline in volume increment was recorded when trees were more than 35 years old. Trees of 50 years old may reach a bole diameter of 60 cm.

Propagation and planting: Seeds for propagation can best be collected when most fruits are still green while about 20% have turned brown. All fruits collected should have grown to the final size. After collection, fruits are packed in gunny-bags. The pulp should be removed within a few days, after which the stones are dried in the shade up to a minimum moisture content of 8.5%, and can be stored subsequently at least one year if they are kept dry and cool. Fruit stones are usually used for propagation; one kg contains 2500–3000 stones. The germination rate of fresh seeds is 40–50% after 9 weeks. Several seedlings may germinate from one stone because it may contain 1–4 seeds. Soaking in cold water for 24 hours improves germination. Although seedlings are light demanders, they tolerate shade. Wildlings are sometimes also collected for planting.

Seedlings in nurseries are susceptible to damping-off caused by fungal attacks. Parasitic plants of the genus *Cuscuta* can cause serious losses in nursery seedlings.
KEFRI and the Plant Conservation Programme in Kenya maintain a living collection of Vitex fischeri, as well as seed stocks.

Management: The first timber plantation was established in the early 1950s on the slopes of Mount Kenya. In 1973 about 620 ha of plantations were recorded. The rotation for trees planted on farms for timber production is recorded to be 35 years, but in commercial timber plantations with a stand density of 200 trees per ha, a cycle of 45–60 years seems more appropriate. Pruning is recommended to obtain a straight and clear bole. Trees tolerate coppicing. They can also be lopped and pollarded, thus providing farmers with fuelwood while allowing the bole to reach marketable size. Nevertheless efforts to promote planting and conservation of *Vitex fischeri* are hampered by lack of information on its biological and ecological characteristics.
The fungus *Armillaria mellea* often attacks the tree in plantations resulting in a black resin on the stems and in decay accelerated by *Trichoderma* sp. However, this disease is usually not a serious threat and can be controlled by uprooting affected trees at first thinning.

Properties: The heartwood is pale grey-brown and indistinctly demarcated from the sapwood, with heartwood of older trees often dark stained and decorative. The grain is straight or wavy, texture coarse. The wood resembles teak, and often yellows after some time in service. Logs are often rotten in the core. The wood is medium-weight, with a density of 430–570 kg/m³ at 12% moisture content. It air dries easily, with little deformation; the rates of shrinkage are moderate. The wood is easy to saw and work with hand and machine tools. It planes to a smooth surface, but a filler is needed for polishing and varnishing. It nails well. The gluing properties are good, and veneer of excellent quality can be produced. Assessments of the durability of the wood range from non-durable to durable. The heartwood is moderately resistant to impregnation with preservatives, the sapwood is permeable.

Uses: The wood is used for furniture, panelling, veneer and as firewood and for charcoal production. It is suitable for light construction, flooring, joinery, interior trim, shipbuilding, vehicle bodies, toys, carving, turnery...
The blackish pulp of the fruits is edible and eaten raw. Fruits are traded on local markets on a small scale. It has been recorded that the honey produced by bees visiting Vitex fischeri flowers is of superior quality and fetches high prices in the market. Vitex fischeri is planted as a shade tree for crops such as coffee and yam, and may be retained in maize and cassava fields. It is grown as an ornamental and windbreak. It produces a useful mulch and serves as a soil improver.

Source : Thijssen, H.J.C., 2008. Vitex fischeri Gürke. In: Louppe, D., Oteng-Amoako, A.A. & Brink, M. (Editors). Prota 7(1): Timbers/Bois d'œuvre 1. [CD-Rom]. PROTA, Wageningen, Netherlands.

Appendix 13: Recommendations on technical aspects, at TNG and planting sites levels

Significant technical improvements at nursery level as well as at plantation level are possible at one year scale. They include the followings

> Indigenous species selection

The indigenous tree species were chosen in consultation with experts from KEFRI and from ICRAF. Most of these species are native to Aberdare ecological region ("climax species"), and their selection is done according to valid criteria:
- extensive and deep rooting system to ensure soil stability;
- large crown to protect soil from rain impacts and from sun radiations
- a diversity of sizes to rebuild at the end a multi-storey forest;
- various uses such as fruit (at least for frugivorous animals) and honey production as well as improvement of soil fertility (legume trees for example);
- a mix of animal and wind dispersal to ensure a good dispersal of their seeds at the mature stage;
- easiness to grow in the nursery.

For an optimal tree nursery management, planting and plantation management and for a better efficiency of tree services and/or production (non wood products), it is necessary to improve the knowledge on these species. The project could gather, analyze and report in the form of short notes all relevant information on the (main) indigenous species it planted –through scientific and grey literature, specialized data bases, etc. and make this knowledge accessible to all the people involved in the project and other GBM projects.

> Seed quality and germplasm collection

It is usually recommended to buy tree seeds from forestry research institutes or from accredited seeds company to have good quality seeds.

As good quality seeds are expensive, GBM and TNG often prefer to collect seeds themselves. The seeds collection is generally done in the forest or in the vicinity; but it is necessary to remember that the selection of the mother trees is very important regarding seeds and progeny qualities. If a mother tree is badly chosen, it is a high risk to sow seeds and to plant seedlings without promising growth. In addition, that risk is higher with wildings because their age is unknown, so the growth habit may not be correctly evaluated.

For all these reasons, it is recommended to work more closely with KEFRI and ICRAF to select the relevant species for each well defined ecological zone, and to select meticulously, in each zone, the best mother trees for each selected species. Then after , these mother trees will be marked with paint so that the seeds collection could be done from these trees only.

If that rigorous mother tree selection may not succeed in a short time, it will be recommended to buy seeds from KEFRI (or other seed suppliers) to have the best seeds and seedlings quality.

Otherwise, picking up wildings from the forests ground may have some negative impacts on the natural regeneration of indigenous species in the forests. As natural regeneration of trees is the cheapest way to regenerate forests, it is recommended to avoid collecting the wildings from the forest.

> Seeds management

Selected seeds are expensive, so they have to be carefully managed. GMB and TNG complained about the low viability of seeds they bought; this may not resulting from poor seeds quality. Indeed, some seeds show a short live time after collection, and have to be sown immediately after collection or have to be managed in specific way to be kept alive for some weeks. Other seeds show a dormancy that needs to be raised by a specific pre-treatment. All these techniques are often not known by the farmers, and are frequently not well known by foresters themselves. Therefore there is a need in information and training to manage the seeds in the right way and to avoid germination failures as previously met with the seeds bought from KEFRI. And this could be applied for the next long rains season of 2010.

> Seedling production in the nurseries

The nurseries we visited are managed with very good willing by the Tree Nursery Groups members. Nevertheless, they are confronting with some huge challenges as water supply, plastic bags and phyto-pharmaceutical products and working tools acquirement. As TNG members are poor, these challenges are much greater. Actually the GBM contribution seems, in our understanding, limited to only 5000 potting bags per year to each single nursery.

In addition to more continuing education on tree nursery practices, GBM has to help TNGs with supplying nursery inputs, tools and mainly water supply.

- Water supply

In all the nurseries we visited, water supply is a crucial problem. Several times, people told us that the region was a water tower in the past and that water was everywhere present; but now they have to go to the valley to collect water and bring it back to the nursery often through a steep and long slope. Even TNG that are connected to a public water supply line miss water most of the time. The solutions proposed by TNG members, and some of which they have already done, is to build a little dam on the nearest stream, to collect the water from the rain in a water tank or in an artificial pond, or to dig a well.

In our mind, the best solution should be, when possible, to collect rainwater from roofs to a water tank and to send it by gravity to the nursery through a hose when possible. Otherwise

a pump may be necessary to lift it to a barrel where watering cans may be filled; pumps are also needed to lift water from permanent streams or from dams.

As water pumps and water tanks are expensive, GBM is thinking about grouping about 3 TNG at the same nursery. So the seedlings production will increase and the related water supply cost (trough buying pump and tank) reduce. The two last years were particularly dry, so nurseries grouping are urgent as it is urgent to provide the nurseries with the relevant water supply equipment; so the next campaign could take place in very good conditions.

- Nursery practices

It is well known by foresters that seedling quality highly impacts the transplantation success, the growth rate and even the tree behaviour till mature stage of the tree, i.e. the good stability of the tree vis a vis strong winds. Some more appropriate techniques or minor adjustments can improve a lot seedling production and tree growth quality.

Two main problems were observed:

> The first one is that the potting bags are insufficiently filled up with soil and are crammed; this may have at least two consequences: i/ the folding of the plastic bags on their upper sides constraint water poring, proper watering of the soil, and development of the seedlings; ii/ the collapse of the bags during the transport to the field and at planting site.

> The second one is a major problem. During the education of the seedlings in the nursery, the root system goes out of the potting bag through the pot base and extends into the soil. At planting time, a large part of the root system is left into the nursery ground when picking up the seedlings for transport. Only a small part of the root system stays into the potting bag. So the ratio between root system and aerial part of the seedlings is unbalanced –and roots are often wounded. That is the reason why after planting, the root system is enable to supply from the soil the water needed by the aerial part of the seedling. That is the major cause of the drying up of many seedlings we observed a few days after planting. That is also the main reason why watering after planting is necessary to keep the seedlings alive.

The solution is to undercut the root system to avoid that roots develop into the soil but stays and to favour root development into the potting bag. The easiest way to do that is to move the pots every 15 days as soon as the roots come out of the bottom of the pots. Just moving the pots cut the roots and the seedling develops new roots into the pot. So, at the planting time the ratio between soil and aerial parts of the seedling is well balanced. The transplantation (or planting) crisis is shortened because this allows the seedling to use more efficiently and more rapidly the soil water after planting; and post-planting watering may be reduced or sometimes suppressed. Thus, such technical improvement should significantly reduce the work after planting.

A third problem appeared that is secondary but nevertheless important for the planting success: the seedlings are staying for a too long time in the nursery. This may have two consequences : i/longer the seedlings will stay in the nursery later the compensation grant will be paid to the farmers - when it is already considered to be paid too late; ii/ longer the seedlings will stay in the nursery more the ratio between soil and aerial parts of the seedling will be unbalanced; consequently the planting crisis may be higher. To avoid that, it is recommended to plant seedlings of about 30 cm high, maximum. The planting crisis will be shortened and the root system will develop rapidly in the soil to get water; so the drying up of the seedling shoots will be reduced, their growth will be accelerated and rapidly they will pass in high late-start initial taller seedlings.

> Planting

The consultants didn't have the opportunity to observe tree planting. Nevertheless the way as planting is done has high impact on the future trees crop.

- Transportation

Potting bags have to be handled with care and particularly during transportation; the bags have to be well arranged into the lorry or the tractor-trailer to avoid soil disintegration in the potting bags due to transport bumps. The seedlings have also to be abundantly watered before leaving the nursery and protected from the wind during the transport to avoid drying off and to increase survival chances after planting.

- Roots roll up

During raising the seedlings in the nursery, even with a regular roots undercutting, the root system roll up around itself at the bottom of the potting bag until it forms a knot of roots (chignon). That "chignon" has to be removed before planting to avoid that the root system strangles itself and weaken the transplant. But we observed that it is not done while that "chignon" may lead to a bad and slow tree growth or even to a sudden dead of the tree some years after planting. The best way to get rid of that chignon and other spiralled roots is to cut the pot at about one cm above the bottom and to slash (cut one cm deep) the pot from top to bottom. Than the plastic bag has to be removed before planting. In the project, that very important operation is not done because farmers want to reutilise the potting bags for a new nursery campaign. To save some shillings, they compromise the future success of the trees plantations.

- Planting holes

The planting holes we sow are good in size. Nevertheless the topsoil with the rhizome of Kikuyu grass (*Pennisetum clandestinum*) is left near the hole. The topsoil is the richest, and it is a pity to not use that fertility for the transplants. Besides, the technique used results in a hole about 20 cm deep at the bottom of which the seedling is planted; and that should be dangerous to walkers.

Maybe that planting method may present some advantages as accumulate the water from heavy rains in the planting holes or facilitating the weeding; but it should be more accurate to benefit from the top soil fertility in putting it with the grass underneath at the bottom of the hole so that the grass will rot and fertilise the trees.

A problem that should be easily resolved is that the seedlings are to deeply sink into the soil at planting time. Many species don't like to have the collar deep into the soil and react with a longer "plantation crises" or even with a partial or total blight or dieback. So, it is very important to putt the collar at the same level than the top of the soil, or one or two centimetres underneath at the maximum.

- Seedlings protection and weeding

We recommend to plant seedlings when they are about 30 cm in high to reduce the planting crises. The risk that the seedlings should be browsed or destroyed by animals is not much greater then with seedlings one meter tall. So, in public places like schools, roadsides, etc. individual protections have to be put even with taller seedlings. In the forest such protections are not efficient against large animals but some individual protections against rodents may be studied.

The transplants have to be weeded as much as necessary during the three first years after planting to reduce weeds competition and allow a better initial growth. No general rule may be enacted. The weeding frequency depends upon the transplants growth and weeding may be necessary for many years for slow growing trees and may be reduce early for fast growing trees.

- Seedlings survival after planting

Elephants are considered as a major treat against seedlings; but the survival rate of *Prunus africana* that is much appreciated by elephants is about 50%. This should not be a major problem because the survival rate is still sufficient to obtain a close canopy tree crop with time. This should be a problem if elephant destroyed 50% of the living trees year after years; but we don't know if they will do that.

The major problem result in the fact that when the seedlings are browsed, the compensation is not paid and that can cause some frustrations to the planters. That is one of the reasons we propose to modify the compensation system (see below).

Extension and training

So we recommend intensive training to farmers and extension officers on the best planting techniques including the cutting of the bottom of the potting bag. To avoid that farmers want to reutilise the plastic bags, we suggest that new bags should be furnished to the tree nursery groups each year in sufficient quantities, either for the project or for their own production they may sell.

> Dry area sites

The dry area sites bordering the Kikuyu escarpment show many constraints in forest rehabilitation due to successive and long droughts and moreover to overgrazing and trampling by Maasai livestock. TNG invested a lot of time and work in restoring this site, notably by watering the transplants during the dry season; but as these efforts were annihilated by livestock, causing high mortality of seedlings, compensation paid to the groups was very low - not in correspondence with such efforts, and this is questioning the compensation system and tree plantation itself in such difficult cases.

The second question is about the best methods and techniques to restore these sites.

It is suggested to initiate a reflection on the necessity to plant trees in these areas. In the dry sites of the Kikuyu escarpment, one may observe many species naturally grown, although the trees looks like shrubs as a consequence of to heavy browsing. So, as natural regeneration is abundant, one should take advantage of it, without ignoring the need of its protection against browsing and trampling.

A solution is to temporary fence block of natural vegetation during a minimum of 3 to 5 years, protect through continuous watching these areas against livestock to facilitate natural regeneration and allow the existing young trees to recover and develop strongly. These fences should not protect too large areas and should be separated by large spaces from each other so that Maasai livestock and wildlife can circulate easily within the zone and have enough fodder out of these protected areas. Tree plantation within the fenced areas can be envisaged where the soil is bare and regeneration absent.

Appendix 14: GBM Tree Nursery Groups: Statistics Form

1. Tree nursery: _____

2. Network: _____

3. Constituency: _____

4. No of members: _____

5. No of members present in the interview: _____
   Men _____women_____

6. No of seedlings in the nursery: _____

7. Major species in the nursery:

1)	2)	3)
4)	5)	6)
7)	8)	9)
10)	11)	12)

   Total species: _____

8. No of trees planted in forests and public places so far (2006-2009):
9. Species planted in the forests and public places:

1)	2)	3)
4)	5)	6)
7)	7)	9)
10)	11)	12)

   Total no of species: _____

10. Types of group income generating activities:
    1)
    2)
    3)
    4)

11. Amount of income after costs generated last year (2008): Ksh_____

Appendix 15: Summary Table of Interviews with Tree Planting Groups

No.	Statistic	1. Tigoni Network	2. Tiekunu Network	3. Matatu Operators SHG	4. Kwairegi	5.Nyamweru	6.Hekaheka SHG	7. Ndunyu Ruthiu
1.	Water problem?	Yes Pump breaks down frequently	Yes-acute Stream dries up	Yes-water source a little far away	Yes-stream level goes too low	No	Yes-no storage	Yes-no storage
2.	Raising indigenous seedlings?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3.	Raising exotic seedlings?	Yes	No	Yes	No	No	Yes	No
4.	Raising fruit trees?	No	No	No	No	No	No	Yes
5.	Seed collection from surrounding trees/forest?	Yes	Yes	Yes	No	Yes	Yes	Yes
6.	Wildlings collection-surrounding trees/forest?	No	No	No	Yes	Yes	No	No
7.	Buy seeds?	No	No	No	Yes –Ksh 8000-9000/kg	No	No	No
8.	Survival rate so far of forest sites they have planted		40%-forest site	92%-public lands 50%-forest site	80%-forest site	80%	Not captured	Not captured
9.	Dissatisfied with Compensation?	Yes	Yes	Yes	Yes	Yes	Yes	Not captured
10.	Membership has gone down? Total Active	Yes 45 13	Yes 130 78	Not captured 31	Not captured 160-mainly women (men=10)	Yes 55 30	Yes 40 18	Yes 30 15

11.	Groups has problem getting young people?	Yes	No	-	Yes	Yes	Yes	Yes
12.	Main occupation of group members	Casual laborers	Casual laborers	Peasants	Laborers	Peasants	Peasants-on PELIS program	Peasants
13.	Plant some trees in own farm plots?	Yes—only few	Yes	Yes	Yes	Not captured	Yes	Yes –fruit trees
14.	Sell some seedlings in open market?	Yes –but few	No	Yes-very few	No	No	Yes-exotics	Yes-fruit trees
15.	Income generating activity started so far	None	None	None	None	None	None	None
16.	Use of money from compensation Invest in nursery Shared to members	Yes-buy bags School fees	Yes-1/3 Fees, farm inputs	Yes –buy bags School fees	Yes-buy bags School fees	Yes-bags Fees, investment	Yes – transfer to new nursery	Yes – to dig water storage pan Family needs
17.	Request from GBM	Assistance with new water pump	Water pans, watering cans	Water pipe on nursery site, watering cans, sprayer	Assist to trap stream water, bags, spray equipment	Bags, nursery preparation implements	Water storage, bags, nursery preparation implements	Water storage, nursery preparation implements, soil
18.	Income generating Projects envisaged	Not asked	Bee-keeping	Had no thought about it	Fish ponds, bee-keeping	Milk goats	Milk goats, rabbits, bee-keeping	Bee-keeping, rabbits, milk goats
19.	Got low germination with KEFRI seeds?	Yes	Not applicable	Not applicable	Yes	Yes	Not applicable	
20.	Support given by	Training, bags,	Training, bags,	Training, bags	Training, bags	Training, bags,	Training, bags,	Training, bags,

	GBM so far	transport seedlings.	transport seedlings/ soil/people			transport seedlings .	transport soil/ seedlings.	Transport seedlings.
21.	Tree seedlings raised-From GBM-AFD Project analysis records 2007 2008(second semester) 2009(first semester)	33830 19190 12830	Not available 6300 Not available	2500 1350 6200	10850 Not available 4500	Not available 12800 9800	9960 13730 5500	23000 33000 15000

SUMMARY TABLE OF INTERVIEWS WITH TREE PLANTING GROUPS

No.	**Statistic**	**8. Mekaro SHG**	**9. Jembe SHG**	**10. Kianugu SHG**	**11. Marugano SHG**
1.	Water problem?	Yes –no storage, no pump	Yes-stream dries/level goes too low	Yes-water pipe runs dry sometimes	Yes-well sometimes almost dries up
2.	Raising indigenous seedlings?	Yes	Yes	Yes	Yes
3.	Raising exotic seedlings?	No	No	No	Yes
4.	Raising fruit trees?	No	No	Yes	Yes
5.	Seed collection from surrounding trees/forest?	Yes	Yes	No	No
6.	Wildlings collection-surrounding trees/forest?	No	No	Yes	Yes
7.	Buy seeds?	No	No Tried once	No	Yes –jatropha
8.	Survival rate so far of forest sites they have planted	Not captured	Not captured	Not captured	Not captured
9.	Dissatisfied with Compensation?	Yes	Yes	Yes	Yes
10.	Membership has gone down? Total	Not captured 22 Not captured	Yes 30 20	No 30-has many young people	Yes 24 15

	Active				
11.	Group have problem getting young people?	Yes	Yes	Yes	Yes
12.	Main occupation of group members	Peasants	Peasants	Peasants	Peasants
13.	Plant some trees in own farm plots?	Yes—only few	Yes-very few	Yes-exotic, fruit trees	Yes-fruit trees, indigenous.
14.	Sell some seedlings in open market?	No	Few	No	Yes-fruit trees, exotics
15.	Income generating activity started so far	Bee-keeping.	Bee-keeping	None	None
16.	Use of money from compensation Invest in nursery Shared to members	Yes-buy bags, re-locate nursery to new site School fees, bee keeping	Yes-bags Fees, food, buying sheep	Yes –buy bags School fees, food	Yes-buy bags, manure, deepen well, buy jatropha School fees, banana seeds, food
17.	Request from GBM	Assistance with soil, nursery preparation implements, watering cans, seed purchase, water pump/ storage	Watering cans and other nursery preparation implements	Water tank,ursery site, watering cans, soil, greavillia robusta seeds	Assist to dig another well, nursery implements, nursery attendant.
18.	Income generating Projects envisaged	Milk goats	Bee-keeping-20 hives	Had no thought about it	Green house tomatoes
19.	Got low germination with KEFRI seeds?	Not applicable	Yes	Not applicable	Not applicable
20.	Support given by GBM so far	Training, bags, transport seedlings.	Training, bags, transport seedlings	Training, bags	Training, bags
21.	Tree seedlings raised -From GBM-AFD Project analysis records: 2007-2008 (second semester) 2009(first semester)	 18500 5480 500	 4460 12040 6640	 3240 16480 18225	 Not available 1500 1500

MEMBERS OF COMMUNITIES MET IN THE FIELD

1. TIGONI NETWORK

1. Peter Kaigua- GV
2. Francis Maina-Chairman
3. Wilfred Gachina-Member, Chief

2. TIEKUNU NETWORK

Charles Karanja---GV
2. George Njoro
3. John Kaniaru
4. Rachel Muthoni

3. MATATU OPERATORS SHG

1. Peter Waititu- Group Chairman
2. George Mukobo-Member

4. KWAREGI SHG

1. Mary Wanjiku	14. Ziporrah Wandia	27. Ester Wanjiru	40. Wangari Njau
2. Jane Wangari	15. Veronica Wanjiku B.	28. Ester Njeri	41. Peter Kuria
3. Rose Wanjiku	16. Hannah Njeri	29. Tabitha Njeri	42. Helen Wathithi
4. Alice Wangari	17. Ruth Njoki	30. Jane Njoki	43. Simon Gathiru
5. Teresia Wanjiku	18. Mary Wangui	31. Alice Njeri	44. Julius Cira
6.Veronica Wanjiku	19. Felomena Nduta	32. Mary Njeri	45. Anne Wairimu
7. Mary Wanjiku	20. Mary Wambui	33. Monicah Wacuka	46. Leah Wanjiku
8. Teresia Mumbi	21. Lucy Wamuhu	34. Philis Wairimu	47. Hannah Wambui
9. Dorcus Gathoni	22. Teresia Wangari	35. Teresia Wacu	48. George Wango
10. Beth Wanjira	23. Monicah Mumbi	36. Teresia Wairimu	49. Julia Njeri
11. Mary Wangari	24. Elizabeth Wanja	37. Ester Nyambura	50. Janet Wanjiru
12. Ester Wanja	25. Hannah Wanjahi	38. Teresia Wangui	
13. Grace Mutheru	26. Monicah Wamoro	39. Teresia Waithera	

5. NYAMWERU SHG

1. Naomi Muthoni	5. James Mwaura
2. Nyambura Kamau	6. Philip Kariuki
3. Veronica Njoki	7. Flasia Wanjiku
4. Mary Njeri	8. Virginia Thomas

6. HEKA HEKA

1. Robert Mungai	6. Margaret Njoki	11. Mary Wangari	16. Peter Njuguna
2. Elias Muturi	7. Joseph Gicia	12. Jane Wangari	17. Salarin Wanjiru
3. Jamlic Macharia	8. Benjamin Macharia	13. Harun Njogu	18. Jacintah Njoki
4. John Mwangi	9. Joseph Heho	14. Stephen Nganga	19. Paul Kigo
5. John Mugwe	10. Samuel Nganga	15. Paul Kingo	20. Charles Mucheru

7. NDUNYU RUTHIU

1. Jack Kamau	5. Serah Wambui
2. Gedraph Waithuki	6. David Ndungu
3. =Monicah Wanjiru	7. Francis Kamau
4. Mary Wambui	8. Njau Njoroge

8. MEKARO BEE-KEEPING SHG

1. Catherine Muringi	5. Joseph Njoroge
2. Jane Wajiku	6. Alice Muthoni
3. Jeremiah Nderitu	7. Samuel Warutumu
4. Esther Wanjiru	

9. JEMBE SHG

1. Stephen Kamau	5. Susan Wanjiku
2. John Mwangi	6. Margaret Wambui
3. Mwangi Gitahi	7. Richard Komu
4. Margaret Wanjiru	

10. KIANUGU SHG

1. John Ndungu	8. Peter Macharia	15. Daniel Mburu	22. John Njuguna
2. Ndirangu Macharia	9. Rugu Rumana	16. Charles Kuria	23. Paul Njau
3. Smason Irungu	10. Peter Kinyanjui	17. Julius Kuria	24. Jacob Macharia
4. John Rugi	11. Harrison Njoroge	18. James Kanani	25. Alice Nyambura
5. Wambui Ndirangu	12. George Kamau	19. Daniel Gathia	26. Gladys Wanjiru
6. Noah Njuguna	13. David Macharia	20. Moses Ndungu	27. Mary Nyamuya
7. Peter Chege	14. Stanley Macharia	21. Julius Maina	28. Esther Njeri

11. MARUGANO SHG

1. Stephen Ngugi	3. Joseph Muchina	5. Mary Wambui
2. Fredrick Kimani	4. Alice Nyambura	

KEY INFORMANTS MET IN THE FIELD:

1. NYAMWERU SITE-UPLAND FOREST

Green Rangers: 1. James Kamau
2. James Mwaura

2. KAMAE BICARBON SITE:

Green Rangers: 1. Smuel Chege 2. Johnson Kabiru 3. Paul Nduati 4. James Njuguna 5. John Kihubo 6. Patrick Ngugi

Rwafura SHG Chairman: David Muguti
Community Forest Association Official: Benson Muiruri

3. KAHUHO PRIMARY SCHOOL:

1. Charles Maina – Headmaster 2. peter Kariuki-Teacher, Environmental education

4. GETA COMPARTMENT SITE:

1. Green Rangers: 1. Jacob Macharia 2. Peter Ndirangu 3. Richard Komu

5. KAMBATI BEAT COMPATMENT 3 SITE:

Kieni Network Members: 1. Peter Irungu 2. Gabriel Nduati 3. Philip Gachonde

6. EXTENSION OFFICERS:

1. Reuben Nduati-Kipipiri Constituency
2. James Mwangi-North Kinangop Constuituency
3. Jane Olive Wanjiku-Gatundu North Constituency
5. Anne Githaiga-Limuru Constituency

7. GOVERNMENT OFFICIALS

1. James Magina-Warden in Charge, Aberdare National Park-Kenya Wildlife Service
2. James Gicia-Forester-Geta Forest Station, Kenya Forestry Service
3. S.K. Adika- District Water Officer-Kianbu West District. Also member of the GBM local Coordination Unit
4. Edward Muguheli-Lower Upland Constituency
5. Geoffrey Njoroge-South Kinagop Constituency