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ABSTRACT

In less than one century Dayak farmers in Indonesia have shifted from traditional hunting and gathering of forest products to slash and burn agriculture with progressive integration of rubber in agroforestry systems called “jungle rubber”, to rubber monoculture in the 1980’s (based on the use of clonal planting material), and finally to oil palm in the 1990’s. Due to different constraints (*Imperata cylindrica*, a weed, and land scarcity), the farming systems used by Javanese transmigrants in official transmigration programs underwent other changes. Local farmers have progressively integrated export crops and are now linked with international markets. The recent economic crisis in Indonesia (1997-1999) increased the need for development and technical change. A significant degree of coherence was maintained between technical systems and social systems.

The example of the Sintang and Sanggau areas in the province of West Kalimantan (Borneo) allows characterization of the different farming systems, identification of a situational framework and of “pathways for future change”. The different strategies are considered here from the perspective of a regional approach to development. Two major challenges characterize the rubber sector: the transformation of existing jungle rubber (2.5 million ha, 85 % of smallholders’ plantations) into clonal plantations (either in agroforestry or monoculture) and the partial substitution, or complementary activity based on the cultivation of oil palm.

**Introduction**

In Indonesia, most rubber plantations correspond to the extensive agroforestry system called “jungle rubber” (85 % of smallholders’ land, which covers 2.5 million hectares). Since the beginning of the last century, rubber has gradually been integrated into traditional shifting cultivation systems and has become the main source of income in the central plains of West-Kalimantan. Since the beginning of the 1990s and in particular since the crisis in 1997 (Penot, 2001), a combination of political, economic and social events has encouraged changes in farming systems, which were traditionally focused on rubber, as well as in land-use (Geissler, 1999). A study<sup>1</sup> implemented in the West Kalimantan province in 2000 aims to illustrate this phenomenon through analysis of the impact of innovation processes.

The diversity of stakeholders, each with their own development projects and objectives, has created ideal conditions for innovation. Indeed, development projects have played an important role in increasing the population’s overall knowledge and as a result, an improvement in production practices and techniques. The variety of behaviors within our sample led us to try and identify the reasons for the choices made by producers, as well as the factors and issues

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<sup>1</sup> This study is implemented within the SRAP research programme (Smallholder Rubber Agroforestry Project), organised by CIRAD and ICRAF and underway in 3 Indonesian provinces since 1994.

that explain these differences in behavior, and finally to analyze the "strategies" used by the farmers. This methodological approach is based on the identification of "strategic groups of farmers" with similar behaviors and/or strategies irrespective of the system of constraints they have to face.

## **1 A traditional system overcoming crisis through diversification**

In the 1980s and 1990s the government policy for the development of clonal rubber plantations for smallholders at the national scale resulted in the introduction of "clones"<sup>2</sup>, mainly in the form of rubber monoculture. This particular cropping system, which is quite different from the traditional one, is based on a technological package involving a high level of inputs (fertilizers, pesticides and herbicides, cover crops etc.). These sectorial projects affected only 15 % of small rubber producers in Indonesia (350 000 ha). Clonal planting material allows threefold multiplication of rubber yields (from 500 kg/ha/year with jungle rubber to 1500 kg/ha/year with clones). The disadvantage of monoculture lies in the fact that it is not easily reproducible by smallholders due to lack of capital, of credit, of available planting material and of technical information.

Rubber does not yield a return on investments for 6 to 7 years, which is a serious disadvantage compared to oil palm (3 years). In addition, monoculture requires a relatively high starting capital to purchase the necessary inputs for the first three years. The cost of clonal planting material is high and quality and availability leave a lot to be desired, as the emerging network of private nurseries is not yet sufficiently advanced. However, the widely diffused information on clonal improved planting material created a real demand, though replanting became problematic following the disengagement of the Indonesian State from the rubber sector in 1999 (Chambon 2000).

At the same time the development of large private oil palm plantations in the 1990s provided an opportunity for local farmers to develop off-farm activities (temporary jobs on estates) and also enabled them to acquire, with full credit, an oil palm plot in exchange for land. Several structural factors contributed to the need for an increase in the productivity of old jungle rubber. On the one hand, unselected jungle rubber seedlings have limited yield and were ageing. On the other hand, given the new crop alternatives and the cost opportunity, the income generated by jungle rubber could no longer be considered sufficient as the main source of income. In addition, the Indonesian economic crisis and the 1997-2002 rubber price crisis have weakened the financial position of smallholders in Indonesia (Penot 2001).

Indonesia has currently more than 5 million hectares of agroforests of which more than half is under jungle rubber (2.5 million). Recognition by local or national institutions of agroforestry systems based on clonal rubber is quite recent (1997/8). Indeed, since 1970, recognition of the smallholders' sector has drawn attention to the need to introduce a policy for replanting this sector together with incentives to generate productive capital and investment through intensification of plantation. In this context, SRAP (Smallholder Rubber Development Project), a Research-Development program intends to set up an improved agroforestry cropping system based on the use of clonal rubber with on-farm experimentation at a small scale (100 farmers with 27 trials) (Penot 1999). The main objective is to develop rubber-cropping systems that are more productive than jungle rubber and less expensive in terms of investment and maintenance

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<sup>2</sup> Grafted improved rubber planting material.

during the initial years than monoculture. Access to planting material is one of the main constraints. Village budwood gardens have been set up in several villages to boost the production of planting material. Farmers generally welcomed this type of organizational innovation, though they only used it to a varying extent. However, the budwood gardens have already improved the diffusion of improved clonal rubber in agroforestry systems, as well as favored the emergence of a new network of private nurseries.

Our study identified two situations, i) the planting of new plantations with a parallel process of land acquisition, and ii) the replanting of old jungle rubber (renewal of productive capital and introduction of intensification).

For smallholders these structural changes imply technical change and innovation. Technical change is induced by the adoption of clonal planting material, either in monoculture or based on the agroforestry system. At the same time, official and/or spontaneous transmigrations as well as the expansion of oil palm Estates tend to increase pressure on remaining available land. Dayak communities thus feel the need to secure their land and consequently to expand their plantations. In this context of uncertainty, the use of clones results in the reinforcement of land ownership. It also generates an effort to rehabilitate degraded land. At the end of the 1990s, smallholders profited from various farming and extra-agricultural alternatives, e.g. rubber and oil palm monoculture, agroforestry systems, nursery activity, off-farm activities, to diversify their sources of income.

## **2 Local farming systems and framework**

### **2.1 Different strategies in the face of different constraints**

The two ethnic groups have undertaken distinct courses of action in terms of land-use and agricultural practices. The traditional Dayak production system is based on extensive slash and burn rain-fed rice cultivation (*ladang*), with, in the past, the progressive integration of jungle rubber and nowadays, of clonal rubber systems. This system gradually became more intensified (line plantation, maintenance before tapping etc.). Jungle rubber has become economically obsolete. The Dayaks also adopted flooded rice, partially inspired by Javanese transmigrants. Old fallow, jungle rubber and local *Tembawang*s (timber and fruit agroforests) also represent a valuable “reserve” of forest products. Originally, Dayak villages did not have to face the problem of limited land<sup>3</sup>. From the beginning of the 1980s, rubber projects gave some villages access to clones and monoculture techniques. At the end of the 1990s, the setting up of oil palm Estates had the same effect, offering new opportunities with oil palm, which was a new crop for local farmers. Since 1997, producers in villages belonging to the SRAP network have also developed nursery activities and new clonal improved agroforestry plantations. The Javanese who settled as a result of the Transmigration Program have access to a very small area of cultivated land (2.5 ha). They initially focused on intensive irrigated rice (*sawah*), which allowed them to be self sufficient<sup>4</sup>. Initially, the cultivation of fruit, timber and forest species was forbidden as the Javanese were officially supposed to specialize in food crops. They are currently establishing perennial plantations (*rambutan*, rubber, oil palm, pepper) in addition to food-crops<sup>5</sup> (rice, peanuts) on the remaining upland (“dry land” or *ladang*). The majority of Javanese planters also

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<sup>3</sup> The population density is still relatively low with an average of 20 to 30 inhabitants /km<sup>2</sup>.

<sup>4</sup> As long as local plots allowed planting of irrigated rice.

<sup>5</sup> Up to 80 % of transmigrants abandoned their land when they were obliged to limit themselves to foodcrop systems, mainly due to lack of control of *Imperata cylindrica*. Those who stayed on all adopted perennial crops.

own a few cows, which is a good way to accumulate capital. However, most Javanese are obliged to undertake off-farm activities for 3 or 4 months a year in order to meet their family's needs (e.g. purchase of complementary food, paying off loans). Javanese farmers are very open to agricultural intensification opportunities and quickly integrate perennial crops whenever possible and seize any other opportunities for income diversification. Their main constraints are lack of land, limited labor, and high pressure from one weed species, *Imperata cylindrical*, in their deforested plots. Rice cultivation remains a strategic and sometimes "social" crop in both farming systems. It uses up family labor but does not ensure complete self-sufficiency. The extent of production of clonal planting material (nurseries), which represents a relatively new opportunity, varies from village to village, depending on the social, economic and technical status of farmers.

Thus, different strategic groups with different objectives with respect to innovation may co-exist within the same village, (Trouillard, 2001). With respect to improved planting material, we distinguished five type of behavior, a) rubber smallholders developing nurseries as their main activity, b) "high status" smallholders who invest in monoculture, c) smallholders-purchasers who buy clonal planting material, d) autonomous smallholders who produce their own clonal planting material, and e) private nurseries (without plantations). Some villages specialize in one or other of these categories, and are then generally referred to as "nursery villages" (those who produce planting material) or "purchasing villages".

The current situation is characterized by an increase in land scarcity that is accelerated by the increase in private Estates for perennial and industrial plantations (Geissler et al, 2000). The subdivision of plots due to successive inheritance transactions accentuates the trend at the village level and underlines the increasing pressure on natural resources and land in the medium term. In addition, State disengagement implies a reduction in opportunities offered by development projects and in indirect subsidies allocated to agricultural activity. This situation increases the risk of exodus by poor farmers to cities, which, in our study area, has already been observed among young people. In the context of crisis, most producers prefer short-term strategies. This is why it is important to focus on trends, and on the logic behind smallholders' actions to identify the different "strategic groups" in order to propose viable alternatives<sup>6</sup> to these trends. The concept of "strategy" is here understood as a means to implement a "project" with a view to the future i.e. the definition of a range of production targets and the mobilization of the means necessary for their implementation (Mollard 1993). The identification of farmers' strategies through strategic groups enables the search for new markets and opportunities, the identification of the conditions necessary for innovations to emerge, and the provision of support for innovation processes leading to new technologies or improved organization.

## **2.2 The methodological approach**

The study carried out in 2000 concerns the analysis of differential impacts of various proposals and innovation processes on different local cultural societies, the diversity of stakeholders involved and consequently the different possible alternatives for producers. The context is characterized by a rapid change in policies and in the economy where the margin of choice for farmers is relatively limited. The study was implemented within the framework of SRAP<sup>7</sup>, based

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<sup>6</sup> By "viable alternatives", we mean "cropping systems" or "technical pathways" that are ecologically sustainable, economically profitable and physically suitable so they can be easily adopted and integrated into local farming systems.

<sup>7</sup> SRAP = Smallholder Rubber Research Project, implemented by CIRAD, ICRAF, GAPKINDO (the Indonesian rubber association) and local NAR's (IRRI-Sembawa, Indonesian Rubber Research Institute).

on the concept of participatory “*Action Research*”. The project is based on a series of technical and organizational innovations (rubber-based cropping systems, the production of planting material, the organization of farmers around activities<sup>8</sup> etc.) that concern pre-established groups of producers. These groups were characterized according to different constraints within a situational framework. Each situation corresponds to a village that is representative of a homogeneous situation. A situational framework was established comprising 6 types of villages.

We observed a diversity of behaviors in the face of similar innovation processes in relatively homogenous zones, and, sometimes even within the same village. Farmers may have similar medium- and long-term objectives but different short-term ones that justify different choices among available opportunities. This led us to use a “constructivist” approach (Chauveau 1999). In our situational framework, we disregarded geographical and social entities that had previously been defined as operational, such as the villages, in order to consider smallholders as a “strategic unit”. In this way, we were able to emphasize the process from individual decision to collective decision. However, at the village level, a collective decision may have a significant impact on the farmers’ decision-making process with respect to a given problem. Within this framework, we were able to identify behaviors and actions based on similar logic, as well as decisive collective choices or differentiated strategies and, as a consequence, to identify different groups from those that had become apparent in our first sample of villages.

From a methodological point of view, the qualitative analysis of farmers’ strategies led us to use the analytical approach of J.M. Yung and P. Stravinsky (Yung 1994). It consists in classifying behaviors according to a “defensive-offensive” gradient of strategies. “Offensive strategies” describes behaviors whose objective is economic growth, the accumulation of wealth, and the desire to transform and improve the household’s welfare. Defensive strategies are defined as actions aiming at minimizing risks, and securing the family’s current welfare (food security as an objective for instance). We then tried to distinguish the strategic groups, the relations that exist between the groups (study of the networks and family links) and the innovation processes the groups implement.

### **2.3 Criteria for defining a strategic group**

The construction of strategic groups required the use of generic indicators, and in particular i) sources of income, ii) cultivation practices and changes in these practices (replanting or not with clonal rubber, production of planting material for sale, *ladang* or *sawah* for rice production, etc.). The primary sources of income were shown to be rubber and oil palm production, the secondary source being off-farm activities. This indicator describes the principal concern of the farmer at any given time, his capacity for investment and for undertaking a possible range of actions. In other words, it highlights short, medium or long-term strategies. Analysis of sources of income reveals the smallholders’ reaction capacity. Clonal replantation demonstrates a capacity to project in the future, to plan a strategy for the generation of income. Indeed, planting a plantation of perennial crops is basically a long-term savings plan for future retirement and security, and is transmissible to one’s children. Clonal rubber is particularly appealing in this respect since it can be used as a “land marker” (in the sense of securing one’s land). The sale of planting material is

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<sup>8</sup> Prior to 1998, in Indonesia there were no farmers’ representatives or organisations that were independent i.e. not controlled by the government. Farmers’ organisations remain to be created.

another useful indicator since it also reveals receptiveness to innovation through a process of “learning by doing”. This strategy transforms into practice the objective of short-term accumulation of wealth. This indicator is relevant both for individual strategies - with the aim of making short-term profits- and for collective strategies. Increasing the availability of clonal planting material profits the whole community.

The *ladang* (upland crops) and *sawah* (irrigated crops) methods of rice production are significant from a social point of view and have the following functions, a) *production of essential food*: *sawah* conserves its function of food security due to better fertility management and improved productivity, b) *The traditional ladang* rice enables the production of rice wine ("Tuak"), which plays a very important social role in Dayak society, c) *a social standard*: not to practice *ladang* or *sawah* agriculture is often synonymous with negligence and is interpreted by local social groups as an act of laziness even though this type of agriculture is no longer relevant in terms of labor productivity, d) *land-use and land marking*: in particular with respect to *ladang* where land tenure is based on non-division of plots as a means of securing access to sufficient land.

Thus, the practice of *ladang* or *sawah* represents attachment to traditions, the need for self-sufficiency in food production and assigning priority to social standards. The maintaining of such practices out of respect for social standards can thus be interpreted as a defensive strategy in the sense that the producer does not wish to risk the disapproval of his social group. The plantation of local rubber (jungle rubber) no longer fulfills a production function (except in the case of the poorest farmers) but instead the function of land marker.

#### **2.4 Identification of the strategic groups**

On the basis of these criteria, behavior analysis allowed the identification of 7 “strategic groups”.

##### *1) Smallholders who are becoming more and more specialized in clonal rubber*

These smallholders are gradually replacing their ageing jungle rubber with clonal rubber (38 % of those interviewed). Of these, 35 % continue to practice *ladang* but most prefer to buy rice rather than to produce it. 70 % still tap their old jungle rubber. *Ladang* activity is maintained as long as land is available in order to maintain the “right of avail (usage)”.

##### *2) Clonal rubber smallholders who specialize in the production of planting material (nursery)*

This group is composed of Dayak farmers who originally belonged to the first group. They have set up nurseries. They replant clonal rubber in monoculture (50 %), in agroforestry systems with fruit trees (25 %) or with fodder intercrops (25 %). They are former leaders, heads of *kelompok* (farmers’ groups) and often play the role of “knowledge transmitters”.

##### *3) Traditional planters in transition*

This group consists of young Dayaks who work productive jungle rubber units, and who replant clonal rubber as far as their limited means allow. *Ladang* is still a strategic activity in this group, but has a more social than economic function in maintaining the right of use on land. This strategic group is in transition towards group 1.

##### *4) Young smallholder with off-farm activities*

This group of young Dayaks has access to limited labor resources and to limited areas of productive jungle rubber. They favor off-farm activity. Some recognized the opportunity offered by the establishment of nurseries. They lack capital for investment in clonal rubber plantations.

##### *5) The traditional “fence-sitters”*

These Dayak farmers still rely on jungle rubber and *ladang* and have not replanted with clonal rubber. They are the most “conservative” with respect to food security. They did not succeed in

the use of grafting as a means of producing planting material. Lack of capital and technical skills as well as access to appropriate information discouraged them from investing in clonal rubber. If they have access to full credit and a fully identified technological package, they generally move directly to oil palm. Most of them pursue off-farm activities, mainly as workers on private Estates or in local gold mines in order to improve their annual income in the short term.

6) *Opportunist owners of private nurseries and people who pursue multiple activities*

These are mainly employees on private Estates. Production of planting material is currently a side activity that will replace off-farm activity in the near future. Using their own limited means they plant clonal rubber in agroforestry systems, as these systems require less labor and less capital investment. They also plant oil palm and consider any new crop opportunity very favorably. People who pursue multiple activities are mainly Javanese transmigrants who have found themselves in a very precarious position, or people who pursue trading activities as a means of diversifying their income.

7) *Javanese transmigrant opportunists*

This group represents old Javanese farmers who have *sawah* but do not plant clonal rubber because of land scarcity. They pursue commercial activities, particularly cattle rearing and sales. These producers maintain traditional practices and favor the short-term accumulation of wealth with the security of an immediate and regular income while working on the Estates.

### 3) Farmers’ strategies and “pathways”

#### 3.1 Farmers’ strategies

The strategies identified are grouped in the following table:

Type of farmers	Strategies	Type of strategies
Rubber smallholders	Planting and replanting	Offensive
	New planting by young farmers	Offensive
	“fence-sitters”, no plans for the medium term	Defensive
People pursuing multi-activities	Diversification	Offensive
People pursuing multi-activities	Development of trade or production activities (“entrepreneurs”)	Offensive
Workers on Estates	Diversification	Offensive
Workers on Estates	Fence-sitters who give priority to the short term	Defensive

The strategy of replanting with clones is slowed down (or blocked), at least initially, when farmers have access to other alternatives, e.g. off-farm activities or oil palm. Consequently, there is concomitance between short-term strategies (off-farm) and long-term strategies (new plantations or replanting). The current replanting is funded by salaries (off-farm) or income from new oil palm plantations. Our hypothesis is that in the medium term, incomes generated by oil palm plantations will fund replanting with clonal rubber.

Smallholders developed diversification strategies while maintaining traditional practices such as agroforestry. The persistence of traditional practices demonstrates the attachment people have to traditions and social standards, and consequently to cohesion and social structure, at least at the community level (village). Indeed, the whole process of social organization is concerned with the maintenance of these practices, in particular the mobilization of labor. Farmers with an off-farm activity and/or multiple activities display changes in social behavior in the sense that work off the farm implies making concessions with respect to social standards and in particular the

abandonment of the use of labor in the form of " *gotong-royong* " (collective labor) due to lack of availability. This social rupture, together with the economic cost of such labor, may also explain the progressive abandonment of *ladang*.

### 3.2 The strategic groups as the expression of different pathways/courses of action

Farmers' courses of action over time are particularly influenced by their access to projects (clonal rubber, production of planting material/nurseries, oil palm, even *Acacia mangium* on a smaller scale<sup>9</sup>), which were seen as new crop opportunities and as part of the global innovation process. Farmers integrated these alternatives to varying degrees depending on how appropriate the innovations were for them. Different courses of action can be observed in similar contexts.

Three main pathways based on changes in practices emerged from our analysis.

The first pathway emphasizes the shift from jungle rubber to clonal rubber (monoculture or agroforestry). This pathway maintains traditional production systems based on jungle rubber (for Dayaks) and *ladang/sawah* (for transmigrants), with the progressive integration of clonal rubber through access to governmental projects or by their own means (10 to 20 % of farmers accomplished it in this way in the last five years)<sup>10</sup>. This pathway is thus directed towards rubber specialization and improvement in productivity. This trend allows some diversification of activities. Some Javanese farmers integrate this pathway with a move from traditional off-farm and *ladang/sawah* activities to plantations (either oil palm or rubber depending on the opportunities available). This strategy is aimed at securing income and intensifying production. Jungle rubber is expected to decrease progressively and eventually to disappear.

The second pathway is characterized by the "move to off-farm activity and the adoption of oil palm". There is a progressive substitution of similar traditional Dayak or Javanese systems of temporary off-farm activity, which is a short-term strategy, linked with rapid adoption of oil palm as a long-term strategy for the generation of income. In this case jungle rubber is progressively abandoned. But later on, the income from oil palm may be partly invested in new clonal rubber plantations.

The third pathway is "mixed and opportunist". It combines the complementarity of traditional systems (jungle rubber and *ladang*) with off-farm activities and other crop opportunities:, i.e. oil palm (through projects) and clonal rubber (generally using their own means and particularly the production of planting material). Emphasis is put on intensification and crop diversification in order to secure income in the medium and long term.

### Conclusion

Agrarian dynamics are characterized by internal conflicts in rural society and in communities as well as by conflict with other stakeholders (the State, the private Estates etc.), by the dependence on markets (export crops) and on different projects. Proposed development models are often irreversible but the strategies developed by the farmers in the face of such constraints are extremely diverse, and include activities outside the agricultural sector. Innovation through intensification, diversification, and off-farm activities are some of the pathways available to farmers in a global context characterized by market uncertainty and economic crisis.

These pathways represent the baseline of current agrarian dynamics. They have been constantly changing since the end of the 1970s, which saw the introduction of development project policies

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<sup>9</sup> Forestry plantations with *Acacia mangium* are proposed to some farmers by HTI semi governmental Estates (UTI = Hutan Tanaman Industri)

<sup>10</sup> Results from SRAP surveys in Kalimantan (K toruillard, 2000) and in Sumatra (Komardiwan/Penot, 2001).

for perennial crops. In the case of rubber, it took thirty to forty years for clones to technically prevail over jungle rubber (but clonal plantations still only represent 15 % of the total area planted to rubber), whereas less than ten years were sufficient for oil palm to become the new outsider crop thanks to the increase in private Estates. Both a strong innovation process and market pressure drive agricultural dynamics.

These pathways are the result of changes and advances in farming systems that led us to develop prospective scenarios for the future of the West Kalimantan province. The first "all oil palm" scenario would result in the complete abandonment of jungle rubber and *ladang* and their replacement by oil palm. It is a scenario of substitution. The second "diversification" scenario is more balanced with endogenous development of clonal rubber plantations (monoculture or agroforestry) in addition to oil palm, with temporary off-farm activity in the estate sector in order to sustain income during the transition phase. It is a scenario of adjustment and complementarity.

Scenario n° 2 appears to be the most realistic. Indeed, the development of oil palm through private Estates will probably continue for the next ten years given potential land availability and the Indonesian economic context. Land and labor are still plentiful in Indonesia compared to its neighbors, Malaysia, for instance, and this provides room for smallholder development as well as for export crops. Subsequently, the continued development of oil palm and rubber plantations on farmers' own initiatives, in the absence of state or other projects, or alternatively, the establishment of more Estates implies an increase in farmers' organizations like the "Kelompok Tani" as well as access to micro-credits. Clonal rubber systems have great potential, as they are more accessible to local farmers than is oil palm and also ensure ecological sustainability through their agroforestry component. The availability of planting material as well as satisfactory quality are pre-requisites for this type of endogenous development. Scenario n° 1 might develop in highly saturated zones with severe land scarcity such as transmigration areas or in areas entirely under the control of private Estates.

These scenarios remain to be discussed in detail with local stakeholders in order to take into account their concerns and their vision of the future.

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