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PROMOTION OF SHORT ROTATION AGRO AND FARM FORESTRY SYSTEM IN GUJARAT AND MAHARASHTRA BY JK PAPER LIMITED UNIT-CPM

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ABSTRACT

JK Paper Ltd. Unit: CPM has put in pioneering efforts and working with the farming communities in Gujarat and Maharashtra for meeting its raw material requirement by promoting short rotation pulpwood agro and farm forestry plantations on their farm lands. This has created a win-win relationship for farmers as well as industry by helping farmers realize value from their wastelands and helping industry meet its ever increasing demand for raw material on a sustainable basis.

Farmers all over India appreciate the multifarious benefits from trees and they have for decades maintained sporadic naturally grown trees on their farms. Mostly land owners prefer to lease their lands on annual basis instead of growing trees adopting short rotation farm forestry farming. Yet farmers have amply demonstrated, as in the case of clonal *eucalyptus* plantations that many of them are keen to opt for agro-forestry plantations if there are major benefits and substantially higher returns from this option. Some of the most important considerations which facilitate farmers to take positive decision in favour of Farm- forestry as a preferred land use option are high productivity and far better returns compared to agricultural crops. This system has gradually accepted and replacing sugarcane crop by farmers because it was less labour-intensive and labour requirements over the year. Tree farming with *eucalyptus* has now become so popular that irrigated and fertile land to the farmers in Gujarat.

JK Paper unit- CPM is producing high productive, disease resistant and site specific clones of *Eucalyptus*, *Leucaena* and *Casuarina* to the tune of 10 Million per annum and provides technical guidance for planting and maintenance and provides assured buy back of wood at prevailing market price. Till date we have covered about 50000 ha of land under farm forestry plantations of *Leucaena, Eucalyptus* and *Casuarina* in Gujarat and Maharashtra.

Key words: Agro and farm forestry, Farmers, Plantations, Short rotation, Pulpwood.

Introduction

JK Organization was established over 100 years ago and diversified into areas such as Paper, Cement, Tyre and Tubes, Pharmaceuticals, Hybrid seeds, Cosmetics, Audio-magnetic tapes, Automotive belts, Sugar, Dairy products, etc.

JK PAPER LIMITED, a member of JK Organization has two units – JK Paper Ltd, Unit-CPM, located at Fort Songadh, Dist- Tapi, Gujarat and JK Paper Mills located at Rayagada, Orissa. JK Paper Mills was the first paper mill to be accredited with ISO 9001, ISO 14001::2015 and OHSAS 18001:2007 certification. The current capacity of the JKPM (Rayagada) is 3.0 lacs tones per annum of Pulp and Paper production. JK Paper Ltd, Unit CPM (Fort Songadh) has production capacity of 1.46 lacs tones per annum and is also accredited with ISO9001, ISO 14001:2015 and OHSAS 18001:2007 certification.

JK Paper Ltd, Unit: CPM is largest integrated pulp, paper and paperboard industry of Gujarat state. Annual production capacity of Unit: CPM is 146000 MT per annum. Annual Bamboo and Wood requirement of unit: CPM is 250000 MT. We are promoting Agro and farm forestry plantations of Eucalyptus, Subabul and Casuarina species. Every year we are producing 100 Lacs Eucalyptus clones and 60 Lacs seed route plants and distributing it to nearby farmers at subsidized rate. We are providing technical guidance to the farmers for raising pulpwood plantations. We also provide buy back guaranty to the farmers for their matured pulpwood.

Agro forestry is a land use management system in which trees or shrubs are grown around or among crops or pastureland. It combines shrubs and trees in agricultural and forestry technologies to create more diverse, productive, profi, healthy, ecologically sound and sustainable land-use systems (Singh, 1990). Or Agro forestry is a collective name for a land-use system and technology whereby woody perennials are deliberately used on the same land management unit as agricultural crops in some form of spatial arrangement. Farm Forestry:

Farmers takes positive decision in favour of farm-forestry as a preferred landuse.

Farm forestry is the name given to programmes which promote commercial tree growing by farmers on their own land. Farm forestry was defined by NCA (1976) as the practice of forestry in all its aspects in and the around the farms or village lands integrated with other farm operations. National Forest Policy 1988 aims at maintaining one third of the country's total geographical area under forest and tree cover, with particular emphasis on fuel-wood, pulp wood and fodder development. However, as per assessment of India State of Forest report 2013 assessment, the forest cover and tree cover in India has over the years stabilized to 21.23 per cent and 2.78 per cent respectively. As the area under natural forest is difficult to increase, rather many developmental projects like hydro power project, big dam construction, highway construction, electricity, mining, drinking water supply etc. has resulted in diversion of forest land to a large extent. There is hardly any scope to increase the recorded forest area in India. Therefore increase of forest cover and tree cover will not be possible unless afforestation activities in non-forest areas are undertaken. The areas outside forests comprises mainly of private farms, canal bank areas, Road side strips, railway line side strip, blank and degraded land, wasteland, etc. Apart from increasing the tree cover, extension of forestry in non forest areas especially as agro-forestry and farm forestry has tremendous potential to increase production of timber and other wood products and reduce the pressure on natural forests. A land use system, which integrates trees and shrubs on farmlands and rural landscapes to enhance productivity, diversity and ecosystem sustainability, is the agro forestry. Agro forestry can be defined as an integrated self sustaining land management system which involves deliberate introduction/retention of woody components including trees, shrubs, bamboos etc, with agricultural crops including pasture/live stock simultaneously or sequentially on the same unit of land meeting the economical as well as socio-economic needs of the people. The national forest Policy 1952, 1988 and the national Agricultural Policy 2000, Task Force on Greening India 2001, National bamboo Mission 2002 and national Policy on farmers, 2007 has recognized agro forestry as an effective programme for efficient nutrient cycling, enhancement of organic matter in the soil for sustainable agriculture and for improving tree cover. It is a wonderful natural resource management system which in agricultural landscape diversifies and sustains production besides building and strengthening the social institutions.

Agroforestry combines agriculture and forestry technologies to create more integrated, diverse, productive, profitable, healthy and sustainable land use system. It is the science of designing and developing integrated, self-sustainable, land management system that involves the introduction and retention of woody components such as trees, shrubs, bamboos, canes and palm along with agricultural crops including pastures or animals , simultaneously or sequentially on the same unit of land and time to satisfy the ecological as well as socio-economic needs of people.

Material and Methods

JK Paper Ltd, Unit: CPM is located at Fort Songadh, Dist: Tapi, Gujarat was earlier based on Bamboo Raw material from leased forest areas from the year 1960 to 2006. During the year 2006 gregarious flowering was takes place in South Gujarat forest areas due to which productivity of bamboo was reduced from 100000 MT to 20000 MT per annum. Initially Unit: CPM has started social and farm forestry plantation programme of Eucalyptus clone, Casuarina plantation from the year 1997. CPM has also started massive subabul plantation drive from the year 2009 in Tapi, Surat, Navsari, Valsad, Bharuch, Narmada, Vadodara, Panchmahal, Anand, Kheda and Sabarkantha districts of Gujarat and Nandurbar, Dhule, and Jalgaon districts of Maharashtra state. We are mostly targeting agriculture lands, farm bunds, cultivable wastes, Panchayat lands, surplus land available with PSUs, state forest corporation lands etc for plantations under different agro and farm forestry models. With robust plantation research and development work, we have developed site specific, disease resistant and high yielding clones of Eucalyptus, Subabul and Casuarina species which are giving higher wood productivity 3 to 4 times more than seed route plantations in shorter rotation age of 3 years.

Massive subabul plantation programme

Subabul is very fast growing, multipurpose species and useful for paper making, fuel wood and fodder purpose etc. Subabul is leguminous crop and fix atmosphere nitrogen in the soil and helps in improving soil health. In order to improve the magnitude of social forestry program, we have introduced massive Subabul plantation scheme in Gujarat and Maharashtra area through direct seed sowing of hybrid seeds. We are providing quality seeds to the farmers, and appropriate seed treatment in order to speed up the germination. We are providing technical knowhow and buy back guaranty to the farmers. As an extension and motivational efforts, we have arranged local farmers visit to Andhra Pradesh area where thousands of hectare is planted under Subabul plantation.

Till date we have covered about 17000 ha areas under Subabul plantation and plan to covered 2000 ha area in 2017-18.

This program is giving new dimension for increasing income source of BPL farmers through low cost plantation activities along with soil and water conservation.

Spacing adopted for agro forestry plantations

Mostly adopted spacing in agro forestry is 3 M X 1 M or variable size extending to 2 M X 1 M, 1.5 M X 1.5 M etc. In between lines farmers are taking their agri crops as above for 1st year. We have observed there is no effect in agricultural crop production in 1st year and no allolopaphy effect has been observed on agri crops.

Extension and Motivational efforts

We have established strong extension network in association of local influential person including NGO and Government agencies. Farmer's meets are being organized at different villages to develop awareness among the farmer regarding the economic benefit available through pulpwood plantation. As a part of extension program, farmer exposure visits are being organized to Andhra Pradesh, Maharashtra and Gujarat successful plantations. We are also organizing farmer exposure visits to our mill and R and D centre to develop confidence in the farmers by observing our activities in the area of Clonal development and seedling plantation in a scientific way to increase productivity.

We are organizing exhibition stall at different agriculture exhibition held in Gujarat and Maharashtra and giving demonstration to the farmers regarding the economic and environmental benefits of our plantations.

Eucalyptus Clonal propagation at Unit – CPM

In the era of global markets, the development of social and farm forestry plantation for industrial purpose must aim for, among other objectives, increasing industrial competitiveness in the distinct market segments they interact with. In such a scenario, forestry based companies must consider the mode in which the forestry raw material can affect their competitive capacity. The modern concept of competitiveness includes producing products to meet the customer's requirements at low costs, in a sustainable manner and with minimum impact on the environment. Therefore, developing tree breeding programs to obtain quick gains, and also developing cloning systems to have a well established vegetative propagation method becomes important. The vegetative propagation methods should rapidly transform genetic gains obtained through breeding or genetic transformation, in to benefits for the industry. One of the most efficient tools to acquire these objectives is the combination of inter-specific hybridization and establishment of Clonal forestry derived from superior hybrid individuals.

Table 1: Comparison of Subabul, Eucalyptus and Casuarina plantation economics with different agricultural crops per acre basis.

Particulars	Subabul (Rotation 3 Years)	Eucalyptus Clone (Rotation 3 Years)	Casuarina (Rotation 3 Years)	Cotton (1 year)	Castor (9 months)	Rice (5 Months)	Wheat (7 Months)
Total Investment	12500	25400	14500	28140	10000	10640	8500
Total Yield	35	40	30	1500	800	2000	1500
Unit	MT	MT	MT	Kg	Kg	Kg	Kg
Sale Price/ MT (`)	3200	3800	3200	40	35	15	15
Total Revenue	112000	152000	96000	60000	28000	30000	22500
Firewood/rice straw/ wheat straw etc	5000	5000	5000	2000	-	5000	5000
Total Revenue	117000	157000	101000	62000	28000	35000	27500
Expenditure (`)	12500	25400	14500	28140	10000	10640	8500
Net Income (`)	104500	131600	86500	33860	18000	24360	19000
Net Income per Acre per year	34833	43867	28833	33860	18000	24360	19000

Table 2: Year wise farmers meeting, Krishi mela and exhibitions organized by JKPL.

Year	Farmers meet at CPM		Farmers Tour to Andhra Pradesh		Exhibition and Krishi Mela	
	Total Meeting	Total Farmers Nos	Total Tour Nos	Total Farmers Nos	Total nos.	Total Farmers (Nos in Lacs)
2009-10	13	720	5	135	0	0
2010-11	28	1310	2	34	0	0
2011-12	20	470	0	0	2	2.20
2012-13	78	715	0	0	3	0.10
2013-14	165	831	0	0	2	0.10
2014-15	129	305	0	0	2	0.10
2015-16	99	865	0	0	2	0.20
2016-17	57	570	0	0	1	0.10
Total	589	5786	7	169	12	2.80

In this context, hybridization is an alternative promising great impact at relatively low cost in tree breeding program, and which can combine superior wood characteristics with tolerance to biotic and a biotic stress, thus providing source of superior of individuals, capable of yielding genetic gains in plantation productivity and wood properties. Crossing species of different characteristics allows production of complementary wood properties in trees particularly in order to meet industrial raw materials.

Average productivity in natural seed derived plantations is low due to high genetic variability. 80 % of productivity is contributed by just about 20 % of the plants. Hence it is very important to have only the highly productive member of the plantation to improve the productivity per unit area.

In order to improve per unit area productivity of the farmer we have introduce Clonal propagation of Eucalyptus in Gujarat area. Clonal propagation technique is used for mass production of true to type planting stock in which all the genetic superiority of the parent tree is retained. The mean annual increment of *Eucalyptus grandis* plantations in Brazil before attempting genetic improvement and Clonal forestry in 1967 was 15 M^3 / ha / year, but when selected clones were introduce, the yield increase to 70 M^3 / ha / year. Such clones under intensive management have yielded even up to 100 M^3 / ha / year (Zobel, 1993).

The Clonal production technique will have several advantages as under

- Production of quality planting stock.
- Propagation of problem trees
- Maintenance of genetic uniformity
- Production of disease free plants
- Early flowering induction
- Clonal repository
- Maintain genetic gain.

Selection of candidate plus trees

Selected 200 no's of CPTs of Eucalyptus and conducted multi locational trials in randomized block design of above CPTs in our agro climatic conditions to assess their suitability. Measured period increment of above CPTs in terms of height, girth and yield and started the mass multiplication of about 50 superior individual.

Clonal plant production

The branch cuttings obtained from matured trees of Eucalyptus are difficult to root. Authors have developed Clonal hedge garden technique for getting juvenile cuttings for mass multiplications.

In order to increase wood productivity per unit area, we have started clonal propagation at CPM from the year 2002. Presently we have 3600m^2 size state of art mist chambers, 10000m^2 size clonal hedge garden and 15000m^2 open nursery for production of 10 millions superior clones of Eucalyptus, Subabul and Casuarina clones every year.

Research and Development

Clonal propagation is dead end breeding which needs strong R and D support. We are taking up constant R and D for improving per unit area productivity. We have developed seed orchards of Subabul for production of superior seeds. Authors are indentifying new CPTs for development of future clones and planning to produce Subabul clones in future for short term forestry. We have formulated short term strategy and long term strategies and working on research and development in a systemic way.

Results and Discussion

JK Paper Ltd, Unit: CPM's pioneering efforts in agro and farm forestry plantation programme has created sustainable wood raw material resources for JKPL. Similarly is has created massive employment and livelihood opportunities in tribal belt of south Gujarat. The social and economic benefits of agro and farm forestry are mentioned as under:

Increase in green cover

Till date we have promoted about 50000 Ha areas under social and Farm forestry plantation in Gujarat and

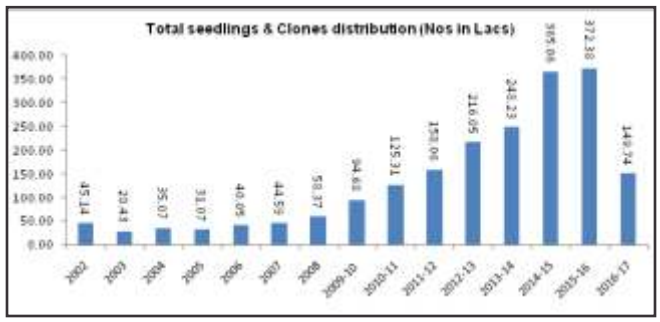

Fig. 1: Year wise no of seedlings and clonal plants distributed (No's in Lacs).

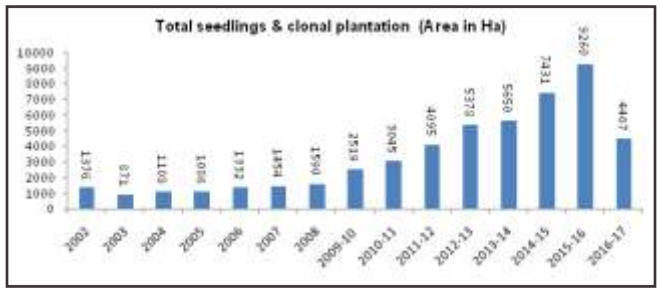

Fig. 2: Year wise area covered under seedling and clonal plantation (in ha).

Picture 1: Subabul intercropping with Castor

Picture 2: Subabul intercropping with cotton

Picture 3: Subabul intercropping with Banana

Picture 4: Subabul intercropping with Beans

Picture 5: Eucalyptus intercropping with Cotton

Picture 6: Eucalyptus intercropping with tobacco

Picture 7: Eucalyptus intercropping with Cabbage

Picture 8: Eucalyptus farm forestry plantation at Surat

Table 3: Year wise plantation and CO_2 absorption from the year 2009-10 to 2016-17.

Year	Plantation Year	Plantation Area in Ha	Total Productivity of Farm forestry plantations promoted by JKPL in Gujarat and Maharashtra.	Total Approximate Carbon sequestrated from these plantations in MT	Carbon Dioxide Absorption / Carbon Dioxide Sequestration in MT from farm
1	2009-10	896	62056	31028	113769
2	2010-11	1460	95753	47877	175547
3	2011-12	3603	143811	71906	263654
4	2012-13	5378	239847	119924	439720
5	2013-14	5650	350864	175432	643251
6	2014-15	7431	483433	241717	886294
7	2015-16	9260	770842	385421	1413210
8	2016-17	4535	593615	296808	1088294

Maharashtra state covering about 66000 farmers.

Employment generations

The social and farm forestry initiatives of JK Paper are contributing significantly for rural employment and helping effectively addressing the problem of poverty in surrounding areas. The 50000 Ha of plantations is creating 11 Lacs man days direct and indirect employment in a year to poor in the activities such as nursery raising, planting and its maintenance, harvesting and transport etc. Every year we are targeting to cover about 4500 Ha of area under social and farm forestry plantations in Gujarat and Maharashtra state.

Wood asset value of plantations

Wood generated from plantations promoted by JKPL is being use for making paper, plywood, poles, furniture etc. The expected year wise value of wood is

Fig.3: Year wise wood assets value from plantation promoted by JKPL.

JKPL plantation initiatives is creating sustainable livelihood amongst the nearby farmers by creating economical wood assets on their farm lands.

Survival % of plantations

We have introduced hi-tech clonal plantations in mill surrounding areas because of which survival% of plantations is over 90% in comparison to 50-60% in ordinary seedlings plantations.

Higher productivity and reduction in rotation age

With continuous research and development efforts, we have developed site specific, disease resistant and fast growing, high yielding clones with 30-50 MT/Ha/Year productivity which is 4-5 times higher than ordinary seedlings plantations. Similarly with the new clones we have reduced the harvest cycle of plantations from 7 years to 3 years.

Bettering the Environment

The value of JKPL farm forestry programme is immense in mitigating environmental degradations. Apart from increasing greenery and tree cover, farm forestry is also having immense potential for Carbon sequestration. The farm forestry is sequestrating/ absorbing million tonnes of carbon dioxide, a potential green house gas. The year wise plantation and CO_2 absorption from the year 2009-10 to 2016-17 is mentioned hereunder (Table 3).

Reduced land requirement

In order to meet out food security for India; agriculture land is under tremendous pressure. Clonal plantations are the ideal option to meet out wood demand of the society. With the productivity of 30-50 MT/Ha/Year less land is required to meet out RM requirement as compare to land requirement at 10 MT/Ha/Year through seedlings plantations.

Total revenue generated to local farmers via wood procured by JKPL

JK Paper Limited, Unit: CPM is purchasing mature wood by nearby farmers on sustainable basis. In order to maximize farmer's income, JKPL is procuring wood directly from farmers. The year wise revenue generated from plantation is mentioned hereunder:

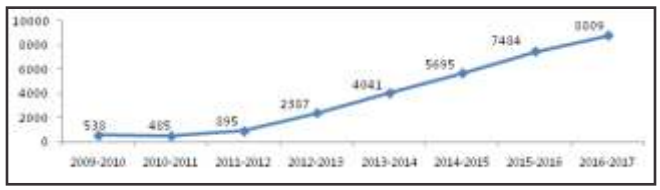

Fig. 4: Total Revenue Generated to Local Farmers via wood procured by JKPL- Rs. Lacs.

Conclusion

In the present Era of industrialization, demand of wood in India is continuously increasing because of increasing populations and consumptions. The Agroforestry and farm forestry plantation initiatives of JK Paper Ltd, Unit: CPM has taken deep roots amongst the farmers of Gujarat and Maharashtra.

The farmers of Gujarat and Maharashtra now adopting suitable Agroforestry and farm forestry model with suitable crop on their farm land and are benefitted. This will also help to increase the depleting forest cover and also it will help to meet the increasing demand of wood based industries of Gujarat state. JK Paper Limited, Unit: CPM has covered about 50000 Ha of agro and farm forestry plantations covering about 66000 nos of farmers. This effort is helping poor BPL farmers, landless labors, transporters, etc and creating sustainable livelihood and employment opportunities in tribal districts of Gujarat and Maharashtra state.

This type of programme should also be launched through State Government so that farmers can take a beneficiary advantage of their crops. This will also enhance the productivity level and increase the forest area.

जे.के. पेपर लिमिटेड यूनिट-सी पी एम द्वारा गुजरात और महाराष्ट्र में अल्प चक्र कृषि एवं फार्म वानिकी प्रणाली को प्रोत्साहन

एन.के. अग्रवाल, ओ.पी. शुक्ला, एस.एल. नारखेडे एवं एस.के.एस. चौहान

सारांश

जे के पेपर लिमिटेड यूनिट : सी पी एम ने अग्रगामी प्रयास किए हैं और गुजरात एवं महाराष्ट्र में कृषि समुदायों के साथ कार्य कर रही है ताकि यह अपनी फार्म भूमियों में अल्प चक्र लुगदी काष्ठ कृषि एवं फार्म वानिकी रोपणों को प्रोत्साहित करके अपने कच्चे पदार्थ की आवश्यकता को पूरा कर सके। इसने पोषणीय आधार पर कच्चे पदार्थ हेतु अपनी सदा वर्धमान माँग को पूरा करने में उद्योगों की सहायता करके और अपनी बंजर भूमियों की कीमत को पूर्ण रूप से समझने में कृषकों की सहायता करके किसानों साथ ही साथ उद्योगों के लिए एक फायदेमंद संबंध सृजित किया है।

पूरे भारत के किसान वृक्षों से विविध लाभों का मूल्य समझते हैं तथा उन्होंने दशकों से अपने फार्मों में छुटपुट प्राकृतिक रूप से उगे वृक्षों को अनुरक्षित किया है। अधिकतर भू स्वामी अल्प चक्र फार्म वानिकी कृषि अपनाकर वृक्षों को उगाने के बजाय सालाना आधार पर अपनी भूमियों को लीज पर देना पसन्द करते हैं। फिर भी किसानों ने प्रचुर मात्रा में प्रदर्शित किया है जैसा क्लोनीय *यूकेलिप्टस* रोपणों के मामलें में है, उनमें से अनेकों कृषि वानिकी रोपणों को अपनाने के लिए इच्छुक है, बर्शते इस विकल्प से प्रमुख लाभ और पर्याप्त मात्रा में उच्च लाभ प्राप्तियां हैं। कुछ सबसे महत्वपूर्ण तर्कों में फसलों की तुलना में उच्च उत्पादकता और कहीं बेहतर प्राप्तियां हैं, जो किसानों को एक पंसदीदा भूमि उपयोग विकल्प के रूप में फार्म वानिकी के पक्ष में सकारात्मक निर्णय लेने के योग्य बनाते हैं। किसानों द्वारा इस प्रणाली को धीरे-धीरे स्वीकार कर लिया गया है तथा गन्ने की फसल का प्रतिस्थापन किया है क्योंकि यह वर्षो तक कम श्रम-गहन और श्रमिक आवश्यकताओं का है। गुजरात में किसानों के लिए सिंचित एवं उर्वरक भूमि में *यूकेलिप्टस* के साथ वृक्ष कृषि अत्यधिक लोकप्रिय बन गई है।

जे के पेपर यूनिट- सी पी एम प्रति वर्ष 10 मिलियन टन तक *यूकेलिप्टस, ल्यूकेना* और *कैज्वारिना* के उच्च उत्पादक, रोग प्रतिरोधी एवं स्थल विशेष क्लोनों का उत्पादन कर रही है तथा रोपण एवं अनुरक्षण के लिए तकनीकी मार्गदर्शन उपलब्ध कराती है और चालू बाजार दर पर काष्ठ की वापस खरीद को सुनिश्चित करती है। आज की तारीख तक हमने गुजरात एवं महाराष्ट्र में *ल्यूकेना, यूकेलिप्टस* एवं *कैज्वारिना* के फार्म वानिकी रोपणों के अन्तर्गत करीब 50,000 हैक्टेयर भूमि को कवर किया है।

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