

PRE-PROJECT STUDY ON SUSTAINABILITY OF APICULTURE IN JAVADHU HILLS: REPORT



TROPICAL INSTITUTE OF ECOLOGICAL SCIENCES (TIES)
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Report on

Pre-project study on Sustainability of Apiculture in Javadhu Hills

Apiculture farmer, Mani, Kilvilamoochi, Javadhu hills, explains about his bee boxes



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I. INTRODUCTION

The word 'apiculture' comes from the Latin word '*apis*' meaning bee. So, apiculture or beekeeping is the care and management of honey bees for the production of honey and the wax. Honey bees come under the *Apis* genus. They are known for producing and storing honey as well as building large nests using the wax secreted by workers in a particular colony. The honey bee is the member of the class Insecta, under the subfamily Apinae. Honey bees are the only insect that produces food consumed by humans.

In apiculture, bees are bred commercially in apiaries, an area where a lot of beehives can be placed. Apiaries can be set up in areas where there are sufficient bee pastures – usually areas that have flowering plants. In India, the common honey bees used in apiculture are *Apis cerana indica* and *Apis mellifera*, among which the former is a native species and latter is foreign. Another common species of the honey bee is *Apis dorsata*, which is not domesticated.

The history of beekeeping and honey gathering goes back many years. The practice of beekeeping can be traced back at least 45,000 years. Some sources state about 40 million years, others claim there are fossilized remains of honey bees dating back 150 million years. The earliest records of humans eating honey (and wax), are believed to date back 10,000 years. This has been indicated in prehistoric drawings found in caves, whilst drawings found in Spain and believed to be around 7,000 years old, appear to indicate a form of beekeeping. Data shows that during 1538, the Spanish imported the first European honey bees to South America.

Approximately one-third of the food we eat is the result of honey bee pollination. A single bee will produce only about 1/12 of a teaspoon of honey in its lifetime. Honey bees offer various commercial food products like honey, honey wax, royal jelly, propolis and bee venom which are used in the preparation of cosmetics, polishes and several medicines. Honey is a highly nutritious food source and is used as an indigenous system of medicine. Royal jelly improves general wellbeing, brain function and promotes the healthy functioning of glands. Propolis, on the other hand, is a natural antibiotic and bee wax helps to keep skin soft and young-looking. Bee venom is an

indispensable ingredient used to desensitize against bee stings. Bee venom from honey bees is used as a treatment for several ailments, including arthritis and high blood pressure.

Bees feed on the nectar and pollen from flowers: the nectar is eventually converted into honey. Bees also collect gums and resins from plants and use plants and trees as habitat for nesting places.

Although impossible to quantify, pollination is the most economically significant value of beekeeping. Flowering plants and their associated bees are interdependent: you cannot have one without the other. It is not only flowers and food crops that are pollinated by bees; trees are also pollinated by them.

Even if a crop is not directly pollinated by a honey bee, the crop still benefits indirectly from being in an environment in which honey bees are working, due to the increased biodiversity in the area which stimulates the crop. Thus beekeeping has ecological, social and economic benefits. Within ecological dimensions, bees are a source of pollinators that help increase crop yields. The economic benefits lie within bee products such as honey, royal jelly, propolis, bee pollen, and bees-wax are highly valuable and have high market price and thus it is an income generating activity. It not only produces a nutritious and high-value food product which generates income, but it also creates employment possibilities along the honey value chain (input provision, production, processing, and marketing). Beekeeping does not consume large amounts of land – a backyard is sufficient – so it releases people from land-demanding activities and reduces pressure on land. Two main economic values could be derived from engaging in beekeeping: income generation from marketing honey and other by-products (beeswax, royal jelly, pollen, propolis, bee colonies, and bee venom) and the creation of non-gender-biased employment opportunities.

II. BACKGROUND

Javadhu hills are spread over two districts of Tamil Nadu namely, Thiruvannamalai and Vellore District. The major portion lies in the Thiruvannamalai District. The forest area consists mainly of deciduous forest and in some places, there are dry deciduous too. Thorny and shrubby plants cover mostly over the hills. The population is predominantly tribes. The tribes are mainly farmers, relying on seasonal crops like millets and during the offseason they migrate to other areas in search of Non-Timber Forest Products (NTFP) like honey, custard apple, tamarind, *etc.*

All households in the study area belong to the local *Malayalis* tribe community. The *Malayalis* come under the Twenty-fifth number in the list of Scheduled Tribes in Tamil Nadu. The word *Malai* denotes inhabitant of the hills (*malai* – hill or mountain) hence the name, but the *Malayalis* have not, however, like the Todas of the Nilgiris, any claim to be considered as an ancient hill tribe, but are Tamil speaking people who migrated from the plains to the hills in comparatively recent times, probably during the middle of the eighteenth century. The Baramahal region of Eastern Ghats and is full of hills and hillocks, among them worthy to mention is the Javadhu hills. There is numerous deep-rooted beliefs system in the socio-cultural and religious life of the *Malayali* tribes of Javedhu Hills. A social hierarchy rules parts of *Malayali* life. There is a Govendan, who is the leader of the highest tier, the Mooppan, who is the intermediary between the *Govendan* and the common people, and then the common people on the lowest tier. Also, elders are generally highly respected. Family is very important to the *Malayalis*, and they are not afraid of going out of their ways or being inconvenienced for the sake of the family.

The history of growing honey bees in Javadhu hills dated back to 40-50 years. The tribes use to collect honey from the forest and they started the practice of growing honey bees. Later on, they were supported by Bee-hive Co-operative Society in Jamunamarathur, a group of people who technically aided the tribes and promoted the apiculture. The hills contain sandal trees planted by the Forest Department, which grow widely due to the favorable conditions. The honey produced in Javadhu has high market value and demand, the reason behind this may be the sandal trees. About 20-25 years back a virus

attack devastated the apiculture completely in Javadhu Hills. Due to this reason, the Bee-Hive Co-operative Society which rooted over the area was completely ruined and the apiculture too. The tribes who weredepended on this honey also affected, honey collection was a mode of living for this community, which thus affected the economy badly.Thus it is understood that the community over the Javadhu Hills has a tradition of beekeeping and the people have quite good knowledge in apiculture.

A few years after the virus attack, apiculture has been restarted with the support of many NGO's like SST(Sreenivasan Service Trust) , Hand-in-Hand, CIKS (Centre for Indian Knowledge System); Govt. agencieslike Khadi andHorticulture Department. The aim behind these departments is to increase the livelihood of the people because honey was one of their major selling products. Today there are about 300 and more carrying out apiculture.

TVS as a motor company has its social arm over the empowerment of the backward community and focus on sustainable agriculture. As part of this, they have put forward many activities to improve the socio-economic status of the people. For this, the group has started supporting apiculture farmers to increase the production rate and for its sustainability. This will help to conserve the traditional knowledge and economy.TVS entrusted Tropical Institute of Ecological Sciences (TIES) with the task of conducting a detailed study on Current Status of Apiculture in Javadhu Hills.

III. OBJECTIVES OF THE STUDY

- To assess the current status of apiculture units/households in the Javadhu hills.
- To understand challenges faced by the farmers
- To explore the interest of the existing farmers for doing apiculture
- To find out the suitability of the locality for apiculture

IV. METHODOLOGY

4.1 Study Area

The Javadhu hills lie between 78.35 and 79.35 degree East Longitude and 12.24 and 12.55 North Latitude covering an area of 2,405 km². One sixth of the area of Thiruvannamalai District is covered by reserve forest and hills which is part of Eastern Ghats under Javadhu Hills. The hills have a mean elevation of 762 metres with the highest points being 1094 metres. Of the total area, 14% constitutes forests. The mean annual rainfall is 1,100 mm of which about 480 mm is received in the southwest monsoon period (June – September) and 429 mm in the northeast monsoon period (October – December). About half of the soil of the land is red loam clay and sandy soil.



Fig.1. Location of farmers in the study area

The general climate over the Javadhu Hills is tropical. There is no perennial river in the district. The population is predominantly tribal comprising 91.60% of the total population and these consist mostly of Malayali tribes. There is a small percentage of schedule caste (population 8.40%) present consisting of the Arundithiyar community.

4.2 Community and Biodiversity Survey

The methodology used for the study is the Questionnaire Survey(Annexure II). It was conducted in 30% (80 households) of the total number of apiculture farmers, to collect data like respondents details,the current status of apiculture units, bee box maintenance, honey extraction, marketing, problems faced by farmers, interest levels and location suitability. The random sampling method is deployed for the questionnaire survey. Another survey was conducted to collect basic details from the rest of the farmers covering a total of 230 households (*ie*, 70%) like respondent details, its current status, and its source.Biodiversity estimation was also conducted in the area surrounding the surveying community. The study was completed in 15 days. During the survey feedbacks, suggestions, their other experiences in apiculture and the history of apiculture over the area werealso collected.

V. RESULTS & DISCUSSION

A sample survey covering 80 households for exploring all research questions and a full population census covering all the available 230 households in Javadhu Hills for preparing baseline data were conducted simultaneously, through the door to door visit. The study covered a total of 310 households (sample study-80 + census- 230) of *Malayali* tribe; having an average population of 1550 individuals (average number of members per house is 5). It is found that among the sample population largest family size is 16 and the lowest is 2 (Table 1). All households are small holders except a few, having an average area of 1.99 acres per household (highest among sample population is 6 acres and the lowest is 0.15 acres) (Table 2).

Table 1. Family Size (n=80)	No. of members	Table 2. Land Holding	Area
Mean family size	5	The average area of holding	1.99 acre
Largest family size	16	Highest holding	6 acre
Smallest family size	2	Lowest holding	0.15 acre

Javadhu hills are traditionally known for honey through the major livelihood of the community is farming, especially millets. Surveyed community is also engaged in farming, but almost all houses have at least one bee box.



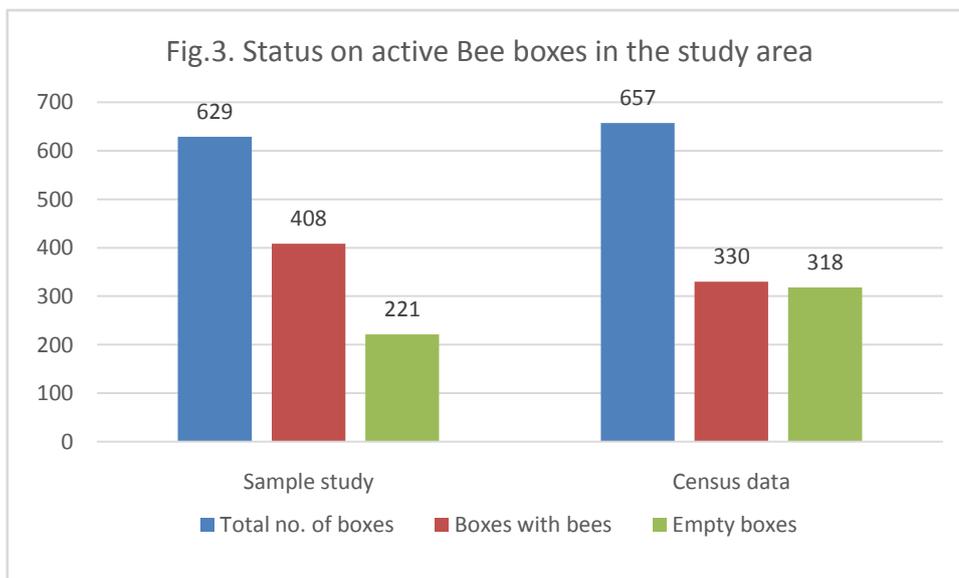
Fig.2 . Bee boxes arranged in the farmer's homesteads.

Table 3. Sample study data on honey boxes available in households (n=80)	No.
Total no. of boxes in all houses	629
Average no. of boxes/house	7.86
Total no. of boxes originally given	466
No. of boxes later added	163
No. of houses where added	12
Total no. of boxes with bees (active)	408
Average no. of active box/ house	5.1
Total no. of empty boxes	219
Average no. of empty box/house	2.73

Table 4. Census data on honey boxes available in households (n=230)	No.
Total no. of boxes	657
Average no. of boxes/house	2.85
Total no. of boxes with bees	339
Average no. of active box/house	1.47
Total no. of empty boxes	318
Average no. of empty box/house	1.38

The census data on available honey boxes shows that a total of 657 boxes are available in the area coming under 230 households (Table 4). However, the sample study population showed that a total of 629 boxes are available in just 80 households (Table 3). The highest number of boxes available in a single house is 110 and the lowest is 1. However, the average number of boxes available in houses is 2.85 only. Among the total 310 households, only four households have above 25 honey boxes. Just one house owns 110 boxes. This means that no households have taken honey rearing as a major livelihood.

Honey boxes have been given by various agencies to the households in two batches. Originally 466 boxes were given to 80 households, but later 163 boxes were added to just 12 houses (Table 3).



Among the available honey boxes, 35% of boxes are empty as per sample study data while census showed that 48% are empty. This shows that on an average, 42% of boxes remain empty throughout the year.

The low number of boxes per house and high percent of empty boxes (2.73 boxes/house) shows that the community has not yet taken it seriously; neither as a livelihood nor as a source of income to the family.

All the boxes available in the households were received from various agencies free of cost.

Table 5. Sources of honey boxes for the community (n=310)

Source of Boxes	No. of households	No. of boxes given	Percent share of donors	Average no. of boxes given to a household
Khadi	39	487	37.86	12.48
SST	204	301	23.4	1.47
Hand in Hand	21	78	6.06	3.71
CIKS	4	26	2.02	6.5
Honey Society	18	159	12.36	8.83
Horticulture	11	49	3.81	4.45
OWN	21	186	14.46	8.85

The highest number of boxes have been given by Khadi (37.8%) followed by SST (23.4%)(Table 5).The average number of boxes given per house is also very high for Khadi (12 boxes/family) whereas SST has given 1-2 boxes (1.47 per house) only. Among the whole community,14.4% of households have taken initiative to make honey boxes by themselves. Other donors have only minor share.

Table 6.Type of wood used for making Bee Boxes (n=80)

Source	No. of boxes given	Teak	Mixed wood	Plastic
SST	54	54	0	0
Khadi	280	0	280	0
Horticulture	43	16	27	0
Honey Society	55	55	0	0
Hand in Hand	18	12	0	6
OWN	163	123	40	0
CIKS	16	16	0	0
Total	629	276	347	6

The wood that is used for making honey boxes of great significance. Primarily it decides the lifespan of the box. Besides, people believe that certain wood types have more preference for honey bees, but no scientific data is available in this regard. Javadhu hill community prefers teak wood as the best choice for making bee boxes considering its long life and their so-called 'preference' towards teak wood. Because of this notion, 75% of boxes made by the households themselves are teak wood. SST and Honey society also provided 100% boxes made out of teak wood. Boxes supplied by Khadiwere made out of another type of woods, excluding teak totally. Another agency, Hand-in-Hand even tried a few plastic boxes, which got no acceptance among the community.

Source	No. of Boxes given	Large	Medium	Small
SST	54	54	0	0
Khadi	280	0	0	280
Horticulture	43	16	0	27
Honey Society	55	55	0	0
Hand in Hand	18	0	12	6
OWN	163	121	2	40
CIKS	16	0	16	0
Total	629	246	30	353

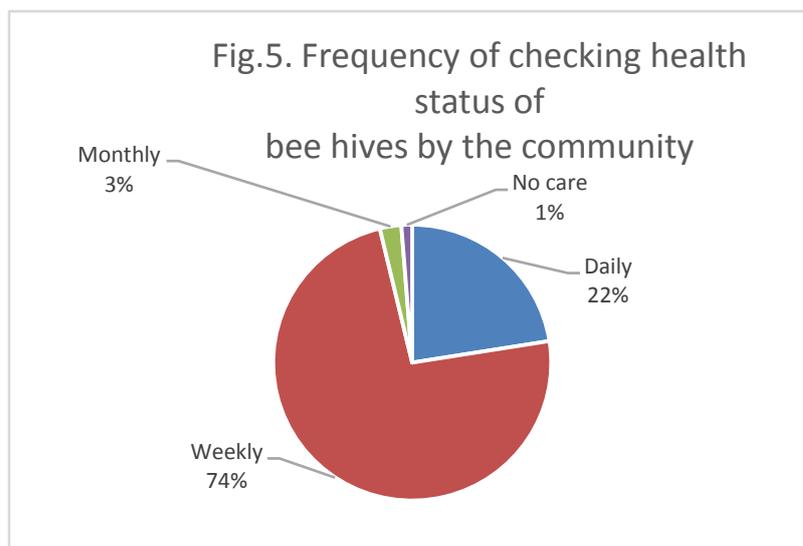
Among the bee boxes distributed among the community, three categories were included such as large, medium and small, based on the overall size of the box. Community is very much preferred for large boxes because they believe that the more size the yield will be more. All the boxes distributed by SST and Honey society are large in size, but other agencies gave large and small together (Table 7). It is well evident that communities' preference is for Teak wood, as 75% of boxes made by them are of large size. However, 56% of the total boxes distributed are small in size.

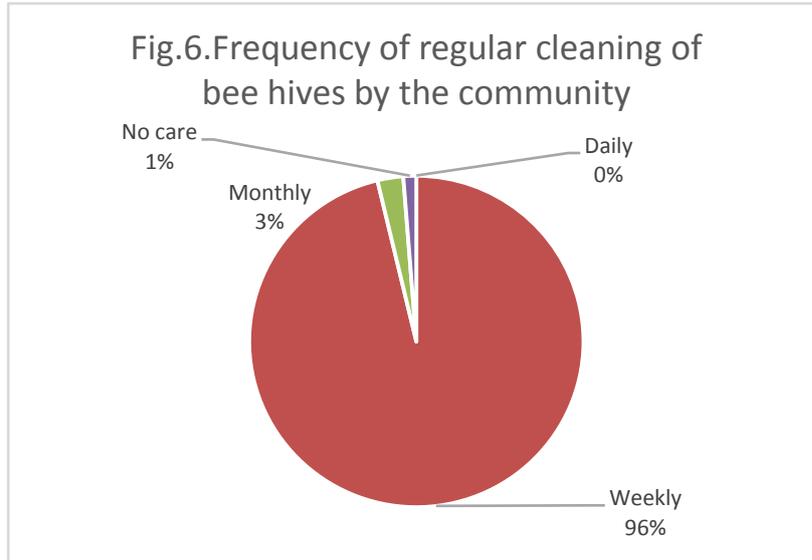


Fig.4. Data collection from farmers

As it is not evolved a major livelihood, involvement of the community in bee keeping activities are also limited. 74% of the respondents check their bee boxes on a weekly basis and only 22% are doing daily checking (Fig.5). This neglect leads to the loss of colonies especially during dry season (April- May; depends on the rain). As the families in grave poverty during dry season, they have not been giving sugar solution as supplementary feed too. 87.5% of the surveyed community doesn't feed colonies during dry season. This also has led to the loss of colonies.

Regular cleaning of bee boxes is an essential activity for the maintenance of colonies and 78% of the community is doing it on a weekly basis (Fig.6). This is sufficient for maintenance but the quality of cleaning work is found imperfect and unscientific. This has resulted in the loss of colonies in many cases or in infections.





Queen cell destruction is another regular activity required for the healthy maintenance of colonies. If more than one queens survived, it will take away some of the worker bees and settle in the wild, forming new colonies, which will affect the colony strength and reduce the honey production. In order to avoid this extra queen cells have to be destroyed in the growth period. It is a skilled job and among the respondents 26.25% of the community are able to do so. Similarly, whenever the population size of a colony exceeds its carrying capacity the colony can be divided. In such cases one more queen will be nurtured and that will be shifted to a new box with associating worker bees. Such division is also a skilled job. Among the community 8.75% of the households knew the technique and hence colony division is limited to such a meagre section.

Table 8. Extraction frequency & production pattern of honey			%
Average Frequency of extraction (days)	18		
No. of houses extracted once in 30 days	20		25
No. of houses extracted once in 60 days	1		1.25
No. of houses extracted once 90 days	4		5
No. of houses extracted once in 15 days	10		12.5
No. of houses extracted once in 7-14 days	30		37.5
No collection	15		18.75

However, whenever honey is stored in the box the community will soon extract it. The survey on the pattern of extraction of honey by the community revealed that the average frequency of extraction is just 18 days during the season (Table 8). 37.5% collect honey once in 7-14 days during the season (summer). Those who have less regular maintenance and checking can collect once in 90 days only; this may be a single collection in a year too.

The average production of honey among the surveyed households also found significantly low; *i.e.*, 12.24 Kg/household/year (total production of 80 houses is just 979 Kg/year). This figure is due to the higher production of 2-3 households and the modal value is 1 Kg/household. Lack of proper checking, cleaning, and maintenance along with the inferior status of the apiculture as a livelihood, led to this low production. Some of the farmers collect honey from the brood chamber of the bee box, which should not be pulled out to collect honey; the super box should be used for that. They are doing this to collect more honey, but actually, it decreases the production because it affects

Table 9. How do they sell Honey?	No.	%
Direct Marketing at home	63	78.75
Through a vendor at home	1	1.25
No production	16	20

the colony strength and health.

Among the surveyed community, there are no problems related to the selling of honey as high demand for 'Javadhu Honey' is existing. Consumers directly approach households and purchase the honey. Few vendors are also collecting honey from households and sell in nearby townships (Table 9). 20% of households have no production at all. It is well evident that there is enough demand for the honey; hence marketing is not an issue. Currently they are getting average price but they are not demanding higher price even though good demand is existing. Limited production and low per house availability are the main factors that pull back the community from demanding higher price.

Table 10. Pattern of usage of honey at own home	No.	%
Regular	15	18.75
Tasting	41	51.25
No usage	22	27.5
With other food	2	2.5

Though honey is anutraceutical product, community use is very limited. 18.75% of the community members only use the honey regularly in their home (Table 10). Honey is just a produce that fetches money for them.

Table 11. Problems faced by Farmers		
	No. of households	Rank
Colony abandoning	20	2
Climatic issue	79	1
No scientific knowledge	5	5
Infections	8	3
Low quality of box	2	6
Pesticide	6	4
Wild animal attack	0	0
Marketing problem	0	0



Fig.7. Different species of honey bees competing for water during a summer day

The major problems faced by the apiculture farms were listed by the community and climatic issues especially drought ranks first, followed by colony abandoning (Table 11). Infections of the colony and pesticide pollution from cotton farms are also making damage to the bee hives. Hundreds of dead bees can be seen around the boxes occasionally in major cotton rearing areas. This is mainly due to the heavy use of pesticides such as Monocrotophos, Mancozeb, Imidachloprid, Cypermethrin, Corogen etc. in cotton crop. There exists another problem, where the farmers, especially female farmers, are afraid to collect honey due to the fear of bee stings. In such cases they hire a person to collect honey.

Table 12. Training received at least a single session		%	
No training	15		18.75
Khadi	21		26.25
SST	42		52.5
Hand in Hand	1		1.25
Honey Society	1		1.25

About 85% of the surveyed households received at least one training from one of the stakeholder agencies



Fig.8. One of the training session for farmers by Agriculture and Horticulture Department Jamnamarathur

5.1 Biodiversity Estimation

Biodiversity indicates the soundness of ecosystem and ecosystem services. The biodiversity in and around the homestead of each farmer is estimated through direct observation and participatory research method. Different taxa like plants, birds, butterflies, and dragonflies were assessed in and around the homesteads of all farmers in the non-forest area.

This estimation gives an overall idea of biodiversity around our project site and it shows the feasibility of the apiculture project.

5.1.1 Biodiversity in Non-Forest Areas of Javadhu Hills

A. Common flora in Javadhu hills

Javadhu hills have covered with dry-deciduous forest patch. The area has the rich cover of deciduous trees. The nectarine plant diversity over the area is good, but the only problem is the variation in rainfall, as a result, the flowering is also getting delayed. The common nectar plants Table.13 shows the list of the plants seen over the area.

SI.NO	SCIENTIFIC NAME	COMMON NAME
1	<i>Cassia fistula</i>	GOLDEN SHOWER TREE
2	<i>Gmelina arborea</i>	WHITE TEAK
3	<i>Agave americana</i>	AGAVE
4	<i>Murraya koenigii</i>	CURRY LEAF
5	<i>Bridelia retusa</i>	SPINOUS KINO TREE
6	<i>Azadirachta indica</i>	NEEM
7	<i>Rotheca serrata</i>	BLUE FOUNTAIN BUSH
8	<i>Morinda citrifolia</i>	INDIAN MULBERRY
9	<i>Cycas circinalis</i>	CYCAS
10	<i>Datura stramonium</i>	DEVIL'S SNARE
11	<i>Solanum torvum</i>	TURKEY BERRY
12	<i>Caesalpinia pulcherrima</i>	PEACOCK FLOWER
13	<i>Phyllanthus emblica</i>	INDIAN GOOSEBERRY
14	<i>Ricinus communis</i>	CASTOR OIL PLANT
15	<i>Sida acuta</i>	COMMON WIREWEED
16	<i>Centella asiatica</i>	INDIAN PENNYWORT
17	<i>Anisomeles indica</i>	CATMINT
18	<i>Aegle marmelos</i>	BAEL TREE
19	<i>Glycomis pentaphylla</i>	GIN BERRY
20	<i>Vitex negundo</i>	CHINESE CHASTE TREE
21	<i>Bacopa monnieri</i>	THYME LEAVED GRATIOLA
22	<i>Pterocarpus santalinus</i>	RED SANDALWOOD
23	<i>Boerhavia diffusa</i>	SPREADING HOGWEED
24	<i>Citrus limon</i>	LEMON
25	<i>Coccinia grandis</i>	IVY GOURD
26	<i>Rivina humilis</i>	BLOOD BERRY
27	<i>Cryptolepis buchananii</i>	WAXLEAVED CLIMBER
28	<i>Calotropis gigantea</i>	GIANT MILKWEED
29	<i>Abutilon persicum</i>	PERSIAN MALLOW
30	<i>Caesalpinia mimosoides</i>	MIMOSA THORN
31	<i>Osbeckia wightiana</i>	ROUGH SMALL LEAVED SPIDER FLOWER
32	<i>Argemone mexicana</i>	MEXICAN POPPY
33	<i>Asclepias curassavica</i>	INDIAN BLOOD FLOWER
34	<i>Tithonia diversifolia</i>	TREE MARIGOLD
35	<i>Senna occidentalis</i>	COFFEE SENNA
36	<i>Lantana camara</i>	LANTANA
37	<i>Leucasaspera</i>	LEUCAS
38	<i>Cardiospermum halicacabum</i>	BALLOON VINE
39	<i>Moringa oleifera</i>	DRUMSTICK TREE
40	<i>Tectona grandis</i>	TEAK
41	<i>Grevillea robusta</i>	SILVER OAK

42	<i>Mangifera indica</i>	MANGO TREE
43	<i>Albizia saman</i>	RAIN TREE
44	<i>Polyalthia longifolia</i>	INDIAN MAST TREE
45	<i>Eucalyptus globulus</i>	EUCALYPTUS
46	<i>Caryota urens</i>	TODDY PALM
47	<i>Delonix regia</i>	GULMOHAR
48	<i>Pongamia pinnata</i>	INDIAN BEECH TREE
49	<i>Artocarpus heterophyllus</i>	JACKFRUIT
50	<i>Morinda pubescens</i>	MORINDA TREE
51	<i>Peltophorum pterocarpum</i>	COPPER POD
52	<i>Bambusa bamboo</i>	BAMBOO
54	<i>Ceiba pentandra</i>	WHITE SILK COTTON TREE
55	<i>Cocos nucifera</i>	COCONUT
56	<i>Casuarina equisetifolia</i>	CASUARINA
57	<i>Jatropha curcas</i>	PHYSIC NUT
58	<i>Carica papaya</i>	PAPAYA
59	<i>Psidium guajava</i>	GUAVA
60	<i>Wrightia tinctoria</i>	PALA INDIGO
61	<i>Syzygium cumini</i>	BLACK PLUM
62	<i>Carissa carandas</i>	CHERRY
63	<i>Evolvulus alsinoides</i>	DWARF MORNING GLORY
64	<i>Curculigo orchoides</i>	GOLDEN EYE GRASS
65	<i>Plumeria alba</i>	PLUMERIA
66	<i>Ficus bengalensis</i>	BANAYAN TRR
67	<i>Ficus religiosa</i>	PEEPAL TREE
68	<i>Ficus tsjahela</i>	FICUS
69	<i>Terminalia chebula</i>	BLACK MYROBALAN
70	<i>Melia dubia</i>	MALABAR NEEM
71	<i>Crotalaria pallida</i>	CROTALARIA
72	<i>Parthenium hysterophorus</i>	PARTHENIUM
74	<i>Holoptelea integrifolia</i>	INDIAN ELM
75	<i>Wattakaka volubilis</i>	SNEEZE WORT
76	<i>Mimosa pudica</i>	TOUCH ME NOT
77	<i>Punica granatum</i>	POMEGRANATE
78	<i>Indigo feratinctoria</i>	TRUE INDIGO
79	<i>Limonia acidissima</i>	WOOD APPLE
80	<i>Acacia nilotica</i>	ARABIC GUM
81	<i>Terminalia tomentosa</i>	INDIAN LAUREL
82	<i>Terminalia bellerica</i>	BELLERIC MYROBALAN
83	<i>Trewia nudiflora</i>	FALSE WHITE TEAK
84	<i>Actinodaphne bourdillonii</i>	ACTINODAPHNE
85	<i>Ziziphus trinervia</i>	ZIZIPHUS

86	<i>Senna siamea</i>	SENNA
87	<i>Prosopis juliflora</i>	PROSOPIS
88	<i>Dendrocalamus strictus</i>	SOLID BAMBOO
89	<i>Dalbergia sissoo</i>	NORTH INDIAN ROSEWOOD
90	<i>Dalbergia latifolia</i>	INDIAN ROSEWOOD
91	<i>Chromolaena odorata</i>	SIAM WEED
92	<i>Annona squamosa</i>	CUSTARD APPLE
93	<i>Alangium salviifolium</i>	SAGE LEAVED ALANGIUM
94	<i>Anogeissus latifolia</i>	AXLEWOOD
95	<i>Vitex altissima</i>	PEACOCK CHASTE TREE
96	<i>Wedelia trilobata</i>	SINGAPORE DAISY
97	<i>Swietenia macrophylla</i>	MAHOGANY

Table.13: Showing the list of plants

B. Common Birds of Javadhu Hills

The bird population is comparatively less over the area. Table.14 shows the birds observed in the study area.

Sl.No	Scientific Name	Common Name
1	<i>Dicrurus macrocercus</i>	BLACK DRONGO
2	<i>Coracias benghalensis</i>	INDIAN ROLLER
3	<i>Acridotheres tristis</i>	COMMON MYNA
4	<i>Prinia socialis</i>	ASHY PRINIA
5	<i>Prinia inornata</i>	PLAIN PRINIA
6	<i>Turdoides affinis</i>	YELLOW BILLED BABBLER
7	<i>Spilornis cheela</i>	CRESTED SERPENT EAGLE
8	<i>Lonchura punctulata</i>	SCALY-BREASTED MUNIA
9	<i>Pycnonotus jocosus</i>	RED WHISKERED BULBUL
10	<i>Pycnonotus cafer</i>	RED VENTED BULBUL
11	<i>Saxicoloides fulicatus</i>	INDIAN ROBIN
12	<i>Motacilla maderaspatensis</i>	WHITE BROWED WAGTAIL
13	<i>Accipiter badius</i>	SHIKRA
14	<i>Saxicola caprata</i>	PIED BUSHCHAT
15	<i>Passer domesticus</i>	HOUSE SPARROW
16	<i>Corvus splendens</i>	HOUSE CROW
17	<i>Corvus culminatus</i>	INDIAN JUNGLE CROW
18	<i>Sturnia pagodarum</i>	BRAHMINY STARLING
19	<i>Turdoides striata</i>	JUNGLE BABBLER
20	<i>Athene brama</i>	SPOTTED OWLET
21	<i>Glaucidium radiatum</i>	JUNGLE OWLET
22	<i>Ardeola grayii</i>	INDIAN POND HERON
23	<i>Bubulcus ibis</i>	CATTLE EGRET

24	<i>Mesophoyx intermedia</i>	INTERMEDIATE EGRET
25	<i>Elanus caeruleus</i>	BLACK WINGED KITE
26	<i>Amaurornis phoenicurus</i>	WHITE BREASTED WATERHEN
27	<i>Columba livia</i>	ROCK PIGEON
28	<i>Stigmatopelia chinensis</i>	SPOTTED DOVE
29	<i>Psittacula eupatria</i>	ALEXANDRINE PARAKEET
30	<i>Psittacula krameri</i>	ROSE RINGED PARAKEET
31	<i>Psittacula cyanocephala</i>	PLUM HEADED PARAKEET
32	<i>Centropus sinensis</i>	GREATER COUCAL
33	<i>Strix ocellata</i>	MOTTLED WOOD OWL
34	<i>Cypsiurus balasiensis</i>	ASIAN PALM SWIFT
35	<i>Halcyon smyrnensis</i>	WHITE THROATED KINGFISHER
36	<i>Merops orientalis</i>	GREEN BEE EATER
37	<i>Megalaima viridis</i>	WHITE CHEEKED BARBET
38	<i>Megalaima haemacephala</i>	COPPERSMITH BARBET
39	<i>Dinopium benghalense</i>	BLACK RUMPED FLAMEBACK
40	<i>Aegithina tiphia</i>	COMMON IORA
41	<i>Oriolus xanthornus</i>	BLACK HOODED ORIOLE
42	<i>Dendrocitta vagabunda</i>	RUFOUS TREEPIE
43	<i>Parus major</i>	GREAT TIT
44	<i>Alauda gulgula</i>	ORIENTAL SKYLARK
45	<i>Orthotomus sutorius</i>	COMMON TAILORBIRD
46	<i>Acridotheres fuscus</i>	JUNGLE MYNA
47	<i>Copsychus saularis</i>	ORIENTAL MAGPIE ROBIN
48	<i>Chloropsis jerdoni</i>	JERDON'S LEAFBIRD
49	<i>Dicaeum erythrorhynchos</i>	PALE BILLED FLOWERPECKER
50	<i>Cinnyris asiaticus</i>	PURPLE SUNBIRD
51	<i>Leptocoma zeylonicais</i>	PURPLE RUMPED SUNBIRD
52	<i>Ploceus philippinus</i>	BAYA WEAVER
53	<i>Anthus rufulus</i>	PADDYFIELD PIPIT

Table.14 Showing the list of birds

C. Common Butterflies of Javadhu Hills

Javadhu hills have a rich population of butterflies, with less diversity. The common ones seen over the area is Blue tiger and Lime butterfly. As the region receives less rainfall, there issue of water scarcity, this completely affects the butterfly, and there is a struggle for existence. Table.15 shows the list of butterflies seen over there.

Sl.No	Scientific Name	Common Name
1	<i>Tirumala limniace</i>	BLUE TIGER
2	<i>Parantica aglea</i>	GLASSY TIGER
3	<i>Acraea violae</i>	TAWNY COSTER
4	<i>Euploea core</i>	COMMON INDIAN CROW
5	<i>Junonia almana</i>	PEACOCK PANSY
6	<i>Junonia orithya</i>	BLUE PANSY
7	<i>Junonia atlites</i>	GREY PANSY
8	<i>Junonia lemonias</i>	LEMON PANSY
9	<i>Junonia iphita</i>	CHOCOLATE PANSY
10	<i>Graphium nomius</i>	SPOT SWORDTAIL
11	<i>Anaphaeis aurota</i>	PIONEER
12	<i>Pareronia valeria</i>	COMMON WANDERER
13	<i>Papilio demoleus</i>	LIME BUTTERFLY
14	<i>Eurema hecabe</i>	COMMON GRASS YELLOW
15	<i>Captopsilia pomona</i>	COMMON EMIGRANT
16	<i>Papilo polytes</i>	COMMON MORMON
17	<i>Euthalia aconthea</i>	COMMON BARON
18	<i>Pachliopta aristolochiae</i>	COMMON ROSE
19	<i>Pachliopta hector</i>	CRIMSON ROSE
20	<i>Neptis hylas</i>	COMMON SAILOR
21	<i>Danaus chrysippus</i>	PLAIN TIGER
22	<i>Captopsilla pyranthe</i>	MOTTLED EMIGRANT
23	<i>Phalanta phalantha</i>	COMMON LEOPARD
24	<i>Colotis amata</i>	SMALL SALMON ARAB
25	<i>Jamides celeno</i>	COMMON CERULEAN
26	<i>Graphium sarpedon</i>	COMMON BLUEBOTTLE
27	<i>Graphium agamemnon</i>	TAILED JAY
28	<i>Graphium doson</i>	COMMON JAY
29	<i>Papilio clytia</i>	COMMON MIME
30	<i>Papilio crino</i>	COMMON BANDED PEACOCK
31	<i>Cepora nerissa</i>	COMMON GULL
32	<i>Polyura athamas</i>	COMMON NAWAB
33	<i>Neptis jumbah</i>	CHESTNUT STREAKED SAILER
34	<i>Tanaecia lepidae</i>	GREY COUNT
35	<i>Hypolimnas bolina</i>	GREAT EGGFLY
36	<i>Hypolimnas missipus</i>	DANAID EGGFLY

Table.15. Showing the list of butterflies

D. Common Dragonflies & Damselflies of Javadhu Hills

The relative abundance of dragonflies in the area is very less, due to the scarcity of water. Table.16 shows the list of Dragonflies seen over there.

Sl.No.	Scientific Name	Common Name
1	<i>Bradinopyga geminata</i>	GRANITE GHOST
2	<i>Orthetrum luzonicum</i>	TRICOLOURED MARSH HAWK
3	<i>Orthetrum pruinosum</i>	CRIMSON TAILED MARSH HAWK
4	<i>Pantala flavescens</i>	WANDERING GLIDER
5	<i>Diplacodes trivialis</i>	GROUND SKIMMER
6	<i>Brachythemis contaminata</i>	DITCH JEWEL
7	<i>Trithemis aurora</i>	CRIMSON MARSH GLIDER

Table.16 showing the list of Dragonflies

E. Major agricultural crops of Javadhu Hills

Mainly they are cultivating millets, for example, maize, fox-tail millet, little millet, and paddy. Some of them are also doing Marygold and Cotton. Table.17 shows the list of Agricultural crops seen over there.

Sl.No	Scientific Name	Common Name
1	<i>Zea mays</i>	MAIZE
2	<i>Pennisetum glaucum</i>	PEARL MILLET
3	<i>Paspalum scrobiculatum</i>	KODO MILLET
4	<i>Eleusine coracana</i>	FINGER MILLET
5	<i>Setaria italica</i>	FOXTAIL MILLET
6	<i>Panicum sumatrense</i>	LITTLE MILLET
7	<i>Oryza sativa</i>	PADDY
8	<i>Solanum lycopersicum</i>	TOMATO
9	<i>Solanum melongena</i>	BRINJAL
10	<i>Tagetes erecta</i>	MARIGOLD
11	<i>Gossypium hirsutum</i>	COTTON
12	<i>Musa acuminata</i>	BANANA
13	<i>Sesbania grandiflora</i>	AGATI
14	<i>Cucumis sativus</i>	CUCUMBER

Table.17 showing the list of Agricultural crops



Fig.9. Marigold Cultivation

Summary & Conclusions

- The study was conducted in Javadhu hills covering a total number of 310 households (230 households for census data & 80 houses for detailed sample study) belonging to *Malayali* tribe consists of about 1550 individuals. Mean family size is 5 and the largest and smallest family sizes are 16 and 2 respectively.
- All the residents are farmers or daily wage laborers who are working in the neighboring farmlands or their own lands. Most of them are economically extremely poor. Major crops in the area are millets and cotton. Formerly, honey was major livelihood support, but now it is nominal in every home.
- Almost all households are smallland holders and average land size is 1.99 acre (largest 6 acres; smallest 0.15 acre).
- Currently, a total of 1286 bee boxes are available in 310 households. An average number of boxes per house is 4.14. The highest number of bee boxes in a house is 110 (only one house) and the lowest is 1. Modal value for Bee box population is 1.
- Out of the available boxes, 57.38% (738 boxes) of boxes have bees but 42.61% (548 boxes) of boxes are empty. Lack of proper maintenance is the main reason. No household has taken beekeeping as a major livelihood option
- Majority boxes are given to households free of cost by various agencies. The highest number of boxes have been given by Khadi (37.8%) followed by SST (23.4%). The average number of boxes given per house is also very high for Khadi (12 boxes/family) whereas SST has given 1-2 boxes (1.47 per house) only. Among the whole community, 14.4% of households have taken initiative to make honey boxes by themselves. Other donors have an only minor share.
- The wood used to make boxes is of great importance as it is decisive in its life span and honey bee 'preferences'. The community strongly believe that teak wood is the best wood for box making. 75% of boxes made by the households themselves are teak wood. SST and Honey Society also provided 100% boxes made out of teak wood. Boxes supplied by Khadi were made out of another type of woods, excluding teak totally. Another agency, Hand in Hand even tried a few plastic boxes, which has got no acceptance among the community.

- Size of the box also matters for the community. They believe that the bigger the box the more production and colony will be healthy. Among the distributed bee boxes three sizes of boxes were included such as large, medium and small. But boxes made by the community were large in size. The community prefers large boxes made out of teak wood.
- Bee keeping activities especially with regard to regular maintenance is very limited in most of the households. Regular checking of beehives is very essential for healthy colonies, but 74% of the respondents do checking once in a week, whereas 22% doing daily. 78% of the households doing regular cleaning of hives on a weekly basis. Irregular and improper hive maintenance activities are the major cause of colony loss and damages.
- Queen cell destruction and division of colonies are periodically required activities but 26.25% of respondents perform queen cell destruction and 8.75% households only perform division of colonies. The major reason a for high number of empty boxes is the result of this habit.
- An important component of apiculture is the absence of feeding honey bees during the dry season; this is another major reason for the loss of colonies. Only a small portion of the farmers uses to do this feeding. As a result of this there are a lot of empty boxes.
- However, there is an illegal practice (as per Wildlife Protection Act, 1972) of collecting bees from the wild and adapting to the boxes. Interestingly, some agencies those supplied boxes had given instructions and training to the community to collect bees from the wild!! Some of the community members have enough expertise to collect queens from subterranean tunnels or rock crevices with the bare hand and transfer to the boxes. They are paid by other members of the community to collect bees from the wild to populate their boxes.
- Most households have very few boxes and due to the lack of maintenance honey production is very low. Average production is 12.24 Kg/household/year. Modal value is 1 Kg./year. Average production per bee box is just 2.34 Kg/year. 20% of households have zero production only.

- Javadhu Honey is an unofficial brand and is of high demand. Consumers purchase honey directly from households. Hence marketing is not an issue. Beekeepers getting Rs.500/Kg., quite reasonable, but the special and unique Javadhuhoney can fetch more price.
- Though honey is a nutraceutical product, community use is very limited. 18.75% of the community members only use the honey regularly in their home. Honey is just produce that fetches money for them.
- The major problems faced by the apiculture farms were listed by the community and climatic issues especially drought ranks first, followed by colony abandoning. Infections of the colony and pesticide pollution from cotton farms are also making damage to the bee hives. Hundreds of dead bees can be seen around the boxes occasionally in major cotton rearing areas. This is mainly due to the heavy use of pesticides such as Monocrotophos, Mancozeb, Imidachlopid, Cypermethrin, Corogen*etc.* in the cotton crop.
- About 85% of the surveyed households got at least one training from one of the stakeholder agencies. However, more than training, many types of expertise already exist among the community related to beekeeping. Channelizing such expertise for the proper maintenance of beehives is required. If beekeeping becomes a major livelihood, the community will be involved more seriously and thus production and income will step up.
- Javadhu hills are covered with dry deciduous forest patch and the area has the rich cover of deciduous species. The area also has good nectarine plant diversity. There is a rich population of butterflies with less diversity. Bird diversity is less over the area, and the dragonfly diversity is very less, which can be due to the scarcity in water.

Recommendations

- Javadhu community is economically poor and livelihood activities like farming or daily wage jobs are insufficient for their sustenance. Beekeeping can be developed into a supporting livelihood of the entire community providing a significant additional income to families.
- Javadhu Honey is unofficially branded and has a high demand in the market. Honey production should be maximized (5-6 Kg./year/box) by making better community involvement in the maintenance and related activities. Proper monitoring and scientific assistance are required.
- The carrying capacity of the sample study area for the honey boxes was assessed and considering the rich biodiversity potential of the area, it is calculated that 80 households can occupy 2000 boxes with an average of 24 boxes per house (~50 cents). Boxes with bees should be provided to each house as in the given proportion. Collection of wild bees for the boxes is illegal and such practices should be stopped.
- The training given by several agencies to the farmers also promoted the habit of collecting honey bees from the wild and there arises a conservation issue. Moreover, this is not true apiculture practice. To multiply the number of boxes, we need to divide the existing colonies and this is the right way in apiculture. To practice this takes time, so we would provide them with bees instead of encouraging collecting them from wild. For this purpose, an apiculture nursery can be maintained.
- The boxes should not be given as free. A possible number of boxes should be supplied to each house on a loan basis. The loan should be returned only at the time of honey collection. This will make every participant a responsible farmer. The price of the boxes and allied instruments also should be subsidised, hence a nominal amount only will have to be repaid.
- During summer, sugar solution should be provided for the survival of the colony. Because of their financial backwardness such practices do not exist. Hence honey syrup mixed with turmeric powder (Curcumin-highly medicinal) should be

provided to the households during summer to keep the colonies healthy during the dry seasons.

- Regular checking, cleaning, destruction of queen cells and division of colonies should be performed in time and this should be scientifically monitored.
- Honey should be branded, purified and standardized for wide-scale marketing. A Honey Society should be formed involving all stakeholders. The society can purchase honey from households at a better price, provide additional job to the community through the production and marketing of value-added products like flavored honey, propolis, bee wax,*etc.* In this way, the revenue from beekeeping can be distributed all around the year. Society can do banking and microfinance activities too.
- The cotton crop requires heavy usage of pesticides which is damaging to the bees, so instead of cotton other crops like flowers or millets which require a minimum amount of pesticides should be promoted.
- Rainwater harvesting facilities should be promoted in every house in order to overcome the drought in the summer season.

APPENDIX 1.BIODIVERSITY AT JAVADHU HILLS

 <p>Salmon arab</p>	 <p>Common leopard</p>	 <p>Common nawab</p>
 <p>Crimson rose</p>	 <p>Spot swordtail</p>	 <p>Common banded peacock</p>
 <p>Lime butterfly</p>	 <p>Tricolored marsh hawk</p>	 <p>Scarlet marsh glider</p>
 <p>Crimson tailed marsh hawk</p>	 <p>Mud Puddling of blue tiger</p>	 <p>Mexican poppy</p>



Lemon pansy



Coffee senna



Black myrobalan



Grey count



Pioneer



Blue tiger



Common gull



Yellow orange tip



Common Emigrant



Rock bee



Ditch jewel



Dwarf morning glory

APPENDIX II.SURVEY SHEET

Respondent Details					
Name		Phone No			
Occupation		No of Family Members		Area of land owned/leased	
Current status of apiculture units/households					
No of boxes		Source of box			
No originally given		No. added later			
Quality of box	Wood :				
Dimensions					
Condition (tick)	Good	Moderate	Poor	Bad	
Colony strength (tick)	Strong	Weak.If so, why?			
Bee box Maintenance					
Regular checking periodicity					
Regular cleaning periodicity					
Monsoon feeding [Yes/No](tick)			If yes, periodicity?		
Queen cell destruction during harvest season (tick)			Yes No		
Have you been dividing the colonies (tick)			No Yes ,Why?		
Honey Extraction					
Manual	Yes No, Why?				
Honey extractor	Yes NoWhy?				
Frequency of extraction					
Do you know some main nectar plants for bees?					
Which is honey collection season					
Do you have any experience with wild honey collection					
Production during last year	(in kg)				
Marketing					

Mode of Marketing (tick)	Direct (through neighbours) Through local market or shop Through co-operative society Through vendors Others		
Any value added products?			
Any other products harvested from bee boxes?(product & quantity)			
What are the uses of honey in your home	Tasting Consuming regularly As medicine With other foods		
Have you received any training (tick) [Y / N]	If yes, type of training? Trained by?		
Have you received any financial assistance (tick)[Y / N]	If yes, type of assistance? Source of assistance?		
Problems faced by farmers	Marketing issues [Y / N]		
Low quality of mother boxes [Y / N]	Colonies abandoning boxes[Y / N]		
Fungal/bacterial/viral Infections [Y/ N]	Climatic Issues [Y / N]		
Wild Animal Attack [Y/ N]	No scientific knowledge in maintenance [Y/N]		
Assessing Interest levels			
Existing bee keeper	Interested in continuing? [Y / N]Why?		
	Interested in expanding? [Y / N]Why? Which areas of business? Honey production value addition other products (specify)		
Potential beekeeper	What aspect of beekeeping interests you? How many hours a day/week can you spend on bee boxes? What are the difficulties that you foresee? What is your backup plan if the beekeeping venture does not work out?		
Suitability of location for apiculture			
Wild plant (nectarine) diversity (tick)	Good Moderate Poor		
Crop diversity of the area (tick)	Good Moderate Poor		
Capacity of a household to support colonies	(state no. of colonies)		
Notes			



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