Introduction

The proposed study will address the design of an ultra light helicopter that utilizes very low power. This will be achieved by using four very large chord rotors rotating at very low RPM (revolution per minute). The "ground effect phenomena" is important in determining the hover performance. If the hover performance can be predicted correctly, better helicopter design can be made. These new types of helicopters will use less power and hence less fuel. As their rotors are rotating at low RPM, they will also produce less noise. These environmental issues are of prime importance to helicopter designers.

The proposed new helicopter can be used as an agricultural tool for manned or unmanned spraying. This will provide a better solution than the current Remote Control (RC) helicopters used for crop spraying in Japan. Agriculture in the 21st century will see a trend of more machine use as manual labor become scarce. External pressures and diversification of agricultural products will demand high technology, precision and future automation.

Currently, helicopters are utilized greatly in agriculture and forestry. In agriculture, they are mostly used for insecticide spraying. A helicopter, used as "agriculture equipment" is basically a "flying utility vehicle" not unlike a tractor. That is, by changing an attachment, it can be used to scatter seeds, fertilize, to kill weeds, spray insecticides and other useful purposes. This feature makes for more diversified usage of helicopters in farming.

In Japan, up to the year 1996, 620 units of the Yamaha R-50 RC helicopters were sold. This helicopter was primarily used for remote control agricultural spraying. This shows that there is a need for helicopters in agriculture. The challenge is to design a better and cheaper helicopter. A primary design objective is to obtain maximum payload to hover to low speed flight. The way to go is to improve on the pioneering work of Dr. Akira Naito on the YURI 1, a human powered helicopter designed at Nihon University.

Another possibility for this new helicopter is that it can be used for fun and recreational flying. Because of the low power and low fuel consumption, it can also be used as a cheap platform for helicopter flight training. There is also some strategic use for the armed forces such as an observation platform and as a hovering transponder.

Design Baseline – RC and Human Powered Helicopters

In 1980, the Japan Agricultural, Forestry and Fishing Aviation Association (Nosuikyo) decided to invest in the development of an RC helicopter for unmanned spraying.[1] Several types of RC helicopters were considered but the set design goals were finally met by a helicopter developed by Yamaha called the R-50 in 1986. Extensive spray mission flight tests were completed during 1986-87. A satisfactory spray pattern was obtained. Field tests were carried out in 1988 and demonstrations performed at over 100 sites throughout Japan in 1989.

Using unmanned helicopters for agricultural spraying in Japan became