COST-EFFECTIVE SYSTEMS FOR SEEDLING PRODUCTION AND TREE FARM ESTABLISHMENT

Eduardo O. Mangaoang, Edwin D. Cedamon and Arturo E. Pasa

Experiences from the ACIAR Smallholder Forestry Project reveal that production and use of high quality seedlings is a critical consideration for successful tree farming and reforestation activity, considering that most reforestation activities have been largely dependent on nursery-produced seedlings. While the use of polyethylene bags has been the traditional technique in raising seedlings, the planting stock produced often have a deformed or J-shape taproot and may develop to mature trees with poor anchorage in the field. The research project introduced the use of hiko tray as potting containers in seedling production as a way of resolving the problem of J-rooting and producing higher quality seedlings. A economic analysis was conducted to determine the comparative advantage and feasibility of the polybag and hiko tray techniques, with a view of promoting the adoption of the hiko technique among tree farmers, especially the smallholders. Results of the study revealed that the hiko tray technique is superior to the traditional polybag technique in terms of labour efficiency and cost in the nursery and field establishment, aside from the fact that higher quality seedlings are produced which provide the tree farmer with a higher level of assurance of timber harvest and cash income from forestry.

INTRODUCTION

In the Philippines, reforestation and tree planting have been promoted through a number of people-oriented programs and projects, as a means of alleviating poverty among smallholders, to increase domestic supply of wood and eventually rehabilitate the degraded upland environment. As a consequence, smallholder farmers have eventually became major timber producers in many parts of the Philippines (Garrity and Mercado 1993).

Experiences in the ACIAR Smallholder Forestry Project reveal that one critical consideration for successful tree farming and reforestation activities, particularly involving the smallholder farmers, is the production of high quality seedlings or planting stock. Most reforestation activities have been largely dependent on seedlings produced in the nursery. While the use of wildlings has been a common alternative to nursery-grown seedlings, the survival rate after potting has been low, especially for indigenous tree species, due to stress involved from the time of collection to potting operation. Further, direct seeding as an alternative plantation establishment strategy has not gained popularity due to low germination and survival rate.

The usual seedling production technique is the raising of seedlings in polyethylene bags (polybags). Common observations, however, reveals that polybag seedlings usually have a deformed or J-shape taproot, and on outplanting often develop to mature trees with poor anchorage. The ACIAR Smallholder Forestry Project has introduced the use of hiko trays in seedling production as a potential means of resolving the problem of J-root formation and producing higher quality seedlings with sound root formation and ground anchorage when outplanted.

This paper presents a simple comparative economic analysis of using polybags and hiko trays in seedling production, through the nursery and in the field. Some comments are made about the use of hiko trays in seedling production, in terms of feasibility and acceptability, particularly at the level of smallholder farmers.

THE NURSERY AND FIELD-TRIAL RESEARCH

The nursery and field trial research, an early research activity of the ACIAR Smallholder Forestry Project, focused on assessing the growth of seedlings raised in polybags and hiko trays, both in the nursery and when outplanted in the field. Since the project is directed towards promoting farm and community forestry on Leyte Island, the Philippines, the study also examined the economic feasibility of the seedling production techniques, particularly in terms of cost and prospects of their adoption by smallholder farmers. On-campus and on-site research was conducted for the nursery study while the field-trial was undertaken in Barangay Conalum, Inopacan, Valencia, Ormoc City, and Isabel, Leyte. A participatory approach involving farmer-partners was adopted as the main framework of implementation for the on-site nursery and field trial research.

COMPARISON AT THE NURSERY SEEDLING PRODUCTION PHASE

Seedling production activities involved various operations such as seed or wildling collection and storage and preparation of potting mix, up to potting and maintenance of seedlings in the nursery. The economic analysis for the nursery phase focused on the aspect of building-up the nursery germination and transplant shed, potting mix preparation, bagging of potting mix, potting of seedlings, and watering as part of the maintenance activities. Seeds of tree species for the nursery study were assumed to be readily available for the research undertaking, and therefore labour for seed collection was not included in the analysis.

Relative labour efficiency

A comparison of labour efficiency in the use of hiko tray and polybag potting techniques in the nursery can best be illustrated by the process of bagging or filling the container with the potting mix, potting of seedlings and watering. Table 1 shows that bagging efficiency is higher with the use of hiko trays than polybags. Using the traditional polybag technique (bag size of 4” x 6”, or about 10 cm x 15 cm), one person can fill an estimated 250 bags per working day, while with the hiko trays (cell size of 4 cm x 8.5 cm), a total of 1333 cells can be filled with the potting mix per working day for a differential advantage of 1083 available containers ready for the potting operation. This means that labour output in bagging operation when using the hiko tray is 5.33 times that of the polybag technique. The greater bagging efficiency using hiko tray may be due to the stocky and firm nature of the container that made filling with potting mix simpler and quicker. Another contributing factor is the volume of potting mix that each container type requires. In the trial, polybags were used which require 425 cc of potting mix while the hiko cells required only 100 cc.

Production of transplant medium-filled containers to produce 1111 seedlings to establish 1 ha of tree farm at 3 m x 3 m spacing requires only 0.8 mandays of labour, while 4.4 mandays are necessary when using polybag. That is, there is a labour saving of 3.6 mandays when using hiko trays, for sufficient seedlings to plant 1 ha.

Table 1. Number of mandays for bagging, potting and watering operations using polybags and hiko trays (for 1 ha seedling requirement at 3 m x 3 m spacing)

Activity	Polybag	Hiko tray	Difference	Ratio
Bagging 1111 seedlings	4.4	0.8	3.6	5.5
Potting 1111 seedlings	2.32	0.92	1.4	2.5
Watering 1111 seedlings (over a 3-month period)	58.5	29	29.5	2.0

The potting of seedlings is also more efficient when using hiko trays. To pot 1111 young seedlings using polybags will require 2.32 mandays to finish, compared with only 0.92 mandays to do the same when using hiko trays. This can be attributed to the firmness and well-organised cells of the hiko tray, making the potting operation easier and faster.

Watering of 1111 seedlings in hiko tray needs a total of 29 mandays before these are outplanted in the field. On the other hand, watering of seedlings in polybags takes twice as long, such that 29.5 mandays of labour for watering seedlings are saved under the hiko tray technique.

Comparison of cost efficiency

Table 2 shows the comparative cost of polybag and hiko tray seedling containers required to produce 1111 seedlings for a 1 ha tree farm. The cost per piece of a 4" x 6" polybag is estimated at P0.06 while one cell of the hiko tray is P0.10. The cost of a hiko tray cell was estimated based on the market price (in 2000) and its expected useful life of 10 years. To produce the total number of seedlings for a hectare of tree farm will require P66.66 worth of polybags, compared to P111.10 for the hiko cells. Assuming that the cost of other materials for seedling production are the same for both potting techniques, this would mean that when using the hiko tray technique, a tree farmer will be required to spend an additional P44.44 for materials needed for seedling production.

Table 2. Cost of nursery materials and chemicals using the hiko tray and polybag techniques for 1-ha seedling requirement

Item	Quantity	Cost/unit (PhP)	Total cost (PhP)
Chicken wire (m)	16	59	944
Plastic acetate (m)	50	60	3000
Tie wire (kg)	2	35	70
Benlate (pack)	1	260	260
Plastic tray (pc)	3	30	90
Water container (pc)	1	30	30
Plain GI (sheet)	1	140	140
Bamboo (poles)	30	30	900
Container (hiko tray cell, polybag)	1111	0.10/0.06	111.10/66.66
Complete fertiliser, field trial (kg)	286.3	14	4008.2
Total cost (hiko tray)			9553.30
Total cost (polybag)			9508.86
Cost difference			44.44

Table 2 also shows the list of materials and chemicals used in seedling production and the corresponding costs using the polybag and hiko tray techniques. As reflected in the table, the slight difference in the total cost of materials and chemicals is due to the estimated higher cost of hiko cells than polybags. The slightly higher cost of hiko material is

compensated by better labour efficiency which is tantamount to a generally cheaper method than the polybag technique (Table 3), apart from the fact that better quality seedlings are produced.

Table 3. Nursery activities and cost of labour using hiko tray and polybag techniques

Activity	Labour (mandays)	Total cost[a] (PhP)
Hauling of garden soil	5	1000
Hauling of mudpress/rice hull	5	1000
Hauling of sand	1	200
Building of germination/transplant shed	6	1200
Sieving of garden soil and sand	1	200
Sterilization of sand and garden soil	1	200
Resieving of sand and garden soil	1	200
Installation of coconut leaves shade	3	600
Bagging, hiko tray/polybags	0.8/4.4	160/880
Potting of seedlings, hiko tray/polybag	0.92/2.32	184/464
Watering, hiko tray/polybag	29/58.5	5800/11700
Total cost, hiko tray		10744
Total cost, polybag		17644
Difference		6900

a. Based on a wage of 200 PhP per manday.

COMPARISON AT TREE FARM ESTABLISHMENT PHASE

The field-trial study involved major operations such as site preparation, hauling of seedlings from the nursery, field planting, fertiliser application, and maintenance (Table 5). Site preparation activities involved brushing and cleaning of the tree farming site, staking and hole-digging. Maintenance activities, on the other hand, involved ring-weeding and liberation cutting or removal of vines. For the economic analysis of this phase of the study particular attention was paid to efficiency and cost of labour in hauling and field planting using hiko tray and polybag seedlings.

Relative labour efficiency

Table 4 shows that labour efficiency is higher for hauling hiko tray seedlings than those in polybags. Hauling hiko tray seedlings is 3.2 times more efficient than that of the polybag seedlings, such that hauling of 1111 polybag seedlings to establish a 1 ha tree farm will require 44.44 times for an individual, as opposed to only 13.88 times when hiko tray seedlings are used. Assuming that one individual can make four haulings in a day, it will take 11.11 mandays to haul 1111 polybag seedlings from the nursery to the field planting site. Hiko tray seedlings, on the other hand can be hauled in only 3.35 mandays, and in that way a saving of 7.76 mandays labour equivalent is realised.

Table 4. Labour requirement for hauling and field planting of hiko tray and polybag seedlings (mandays/ha)

Activity	Polybag	Hiko tray	Difference	Ratio
Hauling of seedlings				
No. of seedlings/person/haul	25	80	55	3.2
No. of hauls, 1111 seedlings	44.44	13.88	30.56	3.2
Mandays to haul 1111 seedlings (4 haul/person/day)	11.11	3.35	7.76	3.2
Field planting				
Hrs. for 1111 seedlings	11.11	5.92	5.19	1.88
Mandays for 1111 seedlings	1.4	0.74	0.66	1.89

Comparison of cost efficiency

A comparison of labour cost incurred in the field-trial phase reveals that the use of hiko tray seedlings is more cost-efficient than using polybag seedlings (Table 5). Overall, a tree farmer is able to reduce labour cost by as much as 8.42 mandays/ha or a peso equivalent of P1684.00/ha when using hiko tray seedlings. This advantage is due to higher labour efficiency when using the hiko tray technique in the hauling of seedlings as well as field planting.

Table 5. Cost of labour in field planting and maintenance using hiko tray and polybag techniques

Activity	Labour (mandays)	Total cost (P)
Brushing/clearing	59.11	11822
Staking and hole-digging	24.91	4982
Hauling of seedlings, hiko trays/polybags	3.35/11.11	670/2222
Field planting, hiko trays/polybags	0.74/1.4	148/280
Ring weeding, 4x/yr (Yr. 1)	152	30400
Fertiliser application (Yr. 1)	6	1200
Weeding of vines, 2x/yr (Yr.2)	66	13200
Weeding of vines, 2x/yr (Yr.3)	66	13200
Total cost, hiko trays (PhP/ha)	378.11	75622
Total cost, polybags (PhP/ha)	386.53	77306
Difference (PhP/ha)	8.42	1684

a. Labour is priced at 200 PhP/manday.

CONCLUSION

Assessment of the comparative advantage of using hiko trays as opposed to polybags in seedling production can be expanded to consider the quality and realisable volume of timber product produced per hectare over a given time, as well as the level of assurance and amount of cash-equivalent benefits that can be realised when the timber crop reaches maturity.

The use of the introduced hiko tray technique in seedling production is more cost-effective than the polybag technique. It provides a higher labour efficiency in the conduct of seedling production activities, particularly bagging of potting mix, potting of seedlings, and watering. In the same way, stand establishment activities including hauling of seedlings and field planting are also made more efficient. This higher efficiency arises from a reduced labour requirement and also quicker accomplishment, and therefore, reduced cost in producing

seedlings as well as establishment of tree farms – a scenario that is favourable to smallholder farmers who are usually constrained by the availability of time, labour and cash to engage in tree farming. The high quality of seedlings produced in the hiko tray technique may eventually provide the smallholder farmer a higher level of assurance of timber harvest and cash income from forestry. While the initial outlay on hiko trays is high, they are expected to have a useful life of not less than 10 years; polybags can only be used once. How to make this type of seedling container readily available and adoptable for smallholder use is an issue that needs immediate attention.

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