Abstract

An important premise of new crops research in horticulture is that biologically successful new species can lead to successful new industries. Success in a biological sense is a necessary but insufficient condition because successful new crop industries are driven by economic and social factors as well as biological factors, and in practice these three sets of factors interact as a system. How to model any one of the biological, economic or social sub-systems is reasonably well understood, but modelling the dynamics of the whole system is more problematic. This paper presents a descriptive model that may be a first step towards understanding the many pathways that new horticultural industries follow, some towards success and others towards failure. The model adopts the view that the biological and environmental science of developing a new crop species must be considered in the context of new industries as emerging social systems with economic objectives. It argues that the multiple developmental pathways of a new industry reflect the principle of growth through discontinuous change, or punctuated equilibrium. The structure of the model is based around four linked phrases, each described in terms of the activities of the actors within that phase. Punctuations of equilibrium can occur within or between phases, with either negative or positive consequences. In this way multiple pathways of development become possible. New crop examples drawn from horticulture are used to demonstrate the features of these various pathways in practice. With caution, it is concluded that the model could be used as a diagnostic tool to indicate future developmental pathways for a new horticultural industry, or to help identify approaches to intervening in a new industry's development to enhance the likelihood of its success.

Literature Review

This paper examines the relationships between an ecologically well-adapted new crop and an economically successful new industry based on that crop. Its aim is to identify the distinguishing features of pathways that lead to success, stagnation or failure of such new industries.

The vast new crops literature is dominated by cultural, chemical and technological evaluations of new species, usually focused on their adaptability. The role of markets in commercialisation received scant attention until the 1990s (Sattaur, 1991; Caiger, 1993; Galan-Sauco and Rallo, 1993; Robbeelen, 1993; Wood et al., 1994; Wilson et al., 1995), but few authors went further than suggesting there must be markets for new products if successful industries are to develop.

In economics and management there are two theoretical perspectives on new industry development. Conventional industrial economics proposes a linear life cycle driven by competition among firms (Van de Ven and Garud, 1989). In contrast, organisational management and entrepreneurship proposes that new industry emergence is not necessarily linear, and co-operation among firms plays a critical role (Miller and Friesen, 1984). Eldredge and Gould (1972) argue that long periods of relative stability (equilibrium) are punctuated by short periods of major change, followed again by more stable conditions. This punctuated equilibrium model of development offers “promising conceptual tools for understanding newly emerging organizations” (Gersick, 1991) but has received almost no attention in the context of rural industries (Wollin, 1996). Its common themes are the significance of co-operation rather than competition, and the view of new industries as
emerging social systems (Astley, 1985; Tushman and Romanelli, 1985; Van de Ven, 1993; Dawson, 1996).

The Basis of a Model for New Crops

A model of how new crop industries emerge and develop must draw from both biological and social sciences. Biological sciences can explain the agronomic performance of the new crop; social sciences can explain the performance of the new industry. The biological sciences literature suggests that the process of introducing new commercial species begins with an exploration phase (Blase et al., 1981; Theisen, 1978); new species must be subject to cultural and technological evaluation (Knox and Theisan, 1981; CAST, 1984); and cultural knowledge about a new crop is integrated with an understanding of markets (Wood et al., 1994; Wilson et al., 1995). Social sciences literature suggests that a new industry may be viewed as an emerging social system (Van de Ven and Garud, 1989; Van de Ven, 1993); development models should reflect growth through punctuated, discontinuous change (Tushman and Romanelli, 1985; Gersick, 1991; Dawson, 1996; Wollin, 1996); and models should demonstrate the role of both competition and co-operation (Astley, 1985; Van de Ven, 1993).

Elements of a New Model

The model presented (Fig.1) is divided into four phases, where a phase is defined as a time when work, learning and experience may change within certain boundaries but the fundamental approach does not (Gersick, 1991). Phases are subdivided into stages. In keeping with the principle of development through punctuated, discontinuous changes, the model proposes pathways that may cycle back and forth between some states, may change significantly for the worse or better during a transition, and may undergo periods of relative stability within stages or phases.

Structure of the Model

The four phases of the model incorporate a total of seven stages. Each of the four phases is associated with a period (S) of relative stability (S1, S2, S3, S4). These relatively stable units are linked either by punctuations (P) which may have a positive (P+) or negative (P-) effect, or by continuing conditions of relative stability (S). Both positive and negative punctuations may be generated from within the system, or from outside the system.

Analysis of the Model

Phase One – Hunters and Collectors

The initial phase can usually be traced to the efforts of individuals who identify, collect and evaluate new crop species, labelled as ‘product identification’ (Theisen, 1978; Caiger, 1993), ‘bibliographic survey’ (Creech, 1965, cited in Blase et al., 1981), ‘germplasm collection’ (CAST, 1984) or ‘exploratory research’ (Knox and Theisen, 1981). Characteristics of the market, if one even exists, are of little importance, and commercial potential is not the primary motivator.

Stage 1. Hunters. Hunters include botanical explorers and other researchers who scour available information, communicate with holders of germplasm or travel to other regions, hunting for new crop material.

Stage 2. Collectors. Collectors source plant material from hunters and often belong to associations that share their findings about new species. Information is typically couched in terms of ‘growability’ as opposed to productivity, and edibility as opposed to marketability.
Hunters and Collectors are oriented to assembling technical and cultural information in an environment that is co-operative rather than within an economic framework. This phase may sustain itself in a stable state (S1) as long as no candidate species for possible commercialisation appears. The appearance of such a candidate is treated as a punctuation because it provides a pathway to the next phase.

**Phase Two – Quasi-commercialisation**

‘Quasi’-commercialisation gives the outward appearance of commercialisation because returns at this stage are artificially high, induced by novelty value and limited supply, giving misleading signals to prospective participants in a developing industry. This gives the appearance of being driven by market forces but these are forces generated in an artificial marketing environment.

Stage 3. Rising Enthusiasm. Champions for new crop’s commercial potential emerge, along with ‘hype’ about the new crop’s prospects. Champions can display great enthusiasm but they can also promote new crops using unreliable information.

Stage 4. First Commercial Responses. Rising enthusiasm leads to investment decisions based on quasi-commercial data. Yields may be based on small research plots or experience in another country. Marketability (and thus price projections) may be based on very limited quantities of hand selected product sold on a trial basis, or the fact that is possible to produce the product when none is available from any other source. Such information is circulated freely and frequently underpins initial commercial plantings in an emerging industry. If indications from quasi-commercialisation are total unfavourable, this is treated as a negative punctuation because it puts development on a new trajectory. Such a punctuation (P-) leads to ‘failure prior to commercialisation’.

The orientation of activities in this phase still favours technical and cultural activities over marketing activities. It is also a phase of co-operation rather than competition as information circulates freely. If early entrants to an emerging industry are thought of as entrepreneurs, the notion of co-operation among them is consistent with Astley’s (1985) view that the presence of untapped demand permits entrepreneurs to co-exist. Although it seems unlikely that an emerging industry could remain in a quasi-commercialisation, this phase is nevertheless proposed as a time of relative stability (S2) because, in the absence of punctuations, there is likely to be a gradual progression to the next stable state, Dawning of Reality (S3).

**Phase Three – Dawning of Reality**

This is a phase of adjustments to a more realistic view of the future prospects of the emerging industry. Markets begin to reflect consumers’ responses to increasing supplies of the product, and for perennial horticultural crops to supply may continue to increase after prices have begun to fall. This phase links the relatively stable states of phases two and four. A negative punctuation during this phase leads to ‘failure during commercialisation’.

Stage 5. Commercial Marketing Results. After the initial wave of commercial plantings, supply begins to increase and growers cannot invest as much effort per unit of product. More realistic market signals emerge as prices fall and/or the market does not expand as predicted.

Stage 6. Responses to Reality. Once locked in and facing less than expected returns, growers take a longer-term view of industry prospects. There may be lobby groups formed, and calls for more government research and development or assistance in marketing as the realities of the crop’s longer-term prospects begin to sink in. Phase three is a relatively stable state (S3) where progression may be gradual and more or less predictable, but negative punctuations can lead to ‘failure during commercialisation’, and positive punctuations can...
lead to a new round of enthusiasm. In the absence of punctuations, the emerging industry will evolve towards phase four, Sink or Swim.

**Phase Four – Sink or Swim**

The actions of phase four represent coming terms with the new industry’s long term commercial prospects.

Stage 7. The results of rationalisation. Those for whom the disparity between actual and expected results is unmanageable may leave the industry (a negative punctuation labelled ‘failure after commercialisation’) while those who remain may be more determined and better able to resolve problems inhibiting the development of the industry. Industries that do not totally fail may stagnate or regress to the point where only a few individuals produce a small quantity of product, shown as a negative punctuation.

Phase four is the final phase of the model, but it is not to be confused with the late-in-life decline stage of life cycle models of industry growth. Although it represents a shaking-out of an emerging industry, stage four does not lead to decline or death. It is simply a ‘test of the fitting’ as Boulding (1981) states. For the ‘fitting’, it is a period of relative instability where the challenge is to continue to adapt.

**How the Model Links with Practice**

A detailed empirical test of the complete model was based on the emergence and successful development of the New Zealand non-astringent persimmon industry over 30 years from the early 1970’s to the late 1990’s (Collins, 1997). Examples below are drawn from other emerging industries in Australia. Conclusions are drawn from discussions with experts working with each of the crops cited, support the model’s validity.

Phase one of the model is represented by the 220 new crops reported by Fletcher (1998) as under evaluation in Australia at that time. Examples of crops presently in phase two include Echinaneta and industrial hemp. Crops such as cashews and some wildflower species are presently in phase three and non-astringent persimmons and Geraldton wax are in phase four. The once heavily promoted new crops pepino and babaco reached stage four but poor market prospects for their products resulted in stagnation/regression. The jojoba industry reached phase three but virtually disappeared from existence when no commercial potential for its products could be demonstrate (stage three, negative punctuation). Recent availability of high yielding clonal plant material is treated as a positive punctuation (P+) linking phase three back to phase two. The Australia low chill stonefruit industry, grappling with potential oversupply and the need for better marketing strategies, can be shown to have gone through phases one, two and three, and now to be facing phase four stage seven. These details examples demonstrate that the model appears capable of explaining the patterns of development of a range of new crop industries. A less detailed scan of all 35 crops analysed by Wood et al. (1994) found no patterns of development that did not seem unexplainable by the model.

A possible criticism is that the model has so many pathways that any new crop development scenario can be explained by it. While this may be true, the alternative is that the development of new horticultural industries follows a predictable, linear birth-growth-death pattern. A cursory examination of the history of new horticultural crops refutes this proposition, thus any model accommodating the multiple interacting factors and processes of new industry development runs the risk of being criticised as too general. The real test is whether for any particular industry the model provides insights useful to research, development an extension activities that enhance an industry’s likelihood of success.

The model reflects concepts from literature, the practice of new crop development and limited validation using case studies. If further research proves it to be more widely
generaliseable, the model will make an important contribution to both the theory and practice of new industry development in horticulture.
Literature Cited