1. Introduction

My initial contact with Gavin Wright came when I arrived at Yale University from Pakistan in the early summer of 1971 due to the war between Pakistan and India. At the time, I had been a research fellow at the Institute for Development Economics in Karachi as part of a Yale-Ford Foundation project. Ford made a “safety-first” decision to have all Americans return to their country. Gavin was then an Assistant Professor in the Department of Economics at Yale.

The two of us discovered a common interest in tennis (which is what brought us together initially) and farmers’ crop growing decisions. I had done an empirical study of the acreage allocation by peasants in East Pakistan (now Bangladesh) to rice (subsistence crop) and jute (cash crop) and discovered that the very large and very small (tenant) farmers devoted a significant portion of their land to jute which had a higher expected return but also a higher variance than rice. The middle income farmers allocated most of their acreage to rice.

When I pointed out this result to Gavin, he was struck with the parallel crop-growing decisions by farmers in the South during the 19th century with respect to corn (food crop) and
cotton (cash crop). Gavin had collected data on allocation of acreage as a function of income level that revealed how much of a farmer’s land was devoted to each of these two crops.

Data from East Pakistan and the 19th century South both reveal that the cash crop is the risky choice for a subsistence farmer. A farmer who buys his food must consider the yield variance of the cash crop as well as the price variance of both crops. For the farmer who grows and consumes his own crop, only the yield variance is relevant. In Bangladesh, the ratios of standard deviations of jute to rice are between 2 and 3 for different regions of the country (Kunreuther and Wright, 1976). In the 19th century South, the standard deviation of corn obtained in exchange for cotton at market prices was four to five times as great as that of corn grown at home (Wright and Kunreuther, 1975).

Our discovery of a common pattern of crop allocation in two very different parts of the world stimulated us to try and understand why small and large farmers followed a similar pattern. We concluded that they did so for very different reasons. The very large farmers could afford to invest much of their land in a cash crop that had a higher expected return even though there was some chance that the actual yield would produce less revenue than the food crop. Small tenant farmers invested heavily in the cash crop because it offered them an opportunity to get out of debt should they be fortunate to reap a high yield and hence a high financial return. They would not have been in a position to obtain these benefits from the food crop. In other words, the small farmers were gamblers in the hopes that they could extricate themselves from a highly aversive state of the world---being in debt.

We postulated that the middle income farmers followed a safety-first strategy by allocating their land primarily to the food crop. They were concerned that if they devoted too
much acreage to the cash crop and they suffered a bad year they would be forced to borrow money to be able to feed their family. Hence they devoted a considerable portion of their land to rice or corn.

Our discussions and collaboration raised a number of questions regarding individual decision making under uncertainty and the adequacy of the expected utility model to explain why small and large farmers planted their crops in a similar fashion. One possible explanation was that the farmer had a utility function which decreased sharply at some critical income level so that he preferred to gamble in order to avoid poverty. Such behavior is the obverse of the explanation provided by Friedman and Savage (1948) as to why the same individual buys lottery tickets and insurance at the same time. By doing so, she has a chance to become wealthy while taking measures to protect herself against a large loss. The principal difference between the two situations is that a person who loses the lottery can survive without taking drastic action while the farmer who does not have enough to feed his family is forced to borrow or starve.

We concluded that a model whereby farmers sought to maximize their expected return subject to a probabilistic constraint that addressed the opportunity of becoming self-sufficient (small farmers) or avoiding going into debt (middle income farmers) would be a more appropriate behavioral model of choice. More specifically, we postulated that a farmer with present wealth \( W \) needs to make a decision on how much of his land to allocate to crops \( x \) and \( y \) next year. The value of \( W \) consists of a certain amount of land, labor and capital, and the farmer’s decision governs the amount of acreage devoted to the food crop and the cash crop.

The farmer is assumed to allocate \( W \) so as maximize expected return but has certain goals that constrain his behavior. For example, a farmer may have certain minimum requirements that
may be critical to his family’s food needs as well as desired cash returns which he would like to have on hand at the end of the season. The farmer is assumed to rank these goals in order of importance, specify a target level for each goal and tolerable risk levels that the target level will not be met.\(^1\)

As an illustrative example, consider a subsistence farmer living in the South in 1860 who had to determine how much of his land would be devoted to cotton and corn. Farmers would plant enough acres of corn to feed their families with reasonable confidence; only the remaining acreage would be devoted to cotton. By allocating land in this way, farmers could insulate themselves from market fluctuations and ensure themselves with reasonable confidence that they would not go into debt. If small farmers were forced to borrow, or to sell their assets, this would threaten their independence and security. In the 1880s, a decrease in farm size for many small farmers in the South and an increase in their debts forced them to gamble on the cash crop (cotton) in order to have any chance of achieving their critical target level for food. (Wright and Kunreuther, 1975).

As Gavin and I discovered, variants of this safety-first model of decision making were widely used by agricultural economists to explain the allocation of high proportion of land to food crops on small farms. [See Behrman (1968), Boussard and Petit (1967), Lipton (1968) and Roumasset (1976)]. However, none of these studies explained why the very small farmers may have wanted to gamble by devoting a sizeable portion of their acreage to the cash crop.

\(^1\) A more formal model characterizing this safety-first behavior appears in Kunreuther and Wright (1979).
2. Goals and Plans in Decision Making

My discussions with Gavin highlighted the important role that goals appear to play in the decision making process. Thirty years later this idea resurfaced when Dave Krantz and I were examining anomalies in insurance purchasing decisions when viewed through the lens of either expected utility theory or prospect theory. My collaboration with Gavin played an important role in getting me to think about these issues and is a principal reason why I am writing this paper in his honor.

The concept that goals and context have a strong influence on decision making can be traced to Aristotle’s Ethics (circa 350 B.C.E.). There, he highlighted the importance of multiple goods as a basis for making choices and stated that the way in which different goals fit together should vary with the occasion. This concept is consistent with a theory of choice where preferences are constructed based on context (Slovic, 1995) and a decision maker focuses on goals rather than on maximizing happiness or utility. With respect to a farmer’s crop growing decision, there are several goals that are likely to play an important role in how he plans to allocate acreage between alternative crops: obtaining a high financial return, having enough food for the family, and reducing his debt.

Dave Krantz and I proposed a constructed choice model that departs from utility theory in its treatment of multiple goals. In dealing with choices under uncertainty using utility theory, a decision problem is often represented as a matrix (Savage, 1954): the rows represent possible actions or strategies, the columns represent possible events that could occur, and the entry in any

---

2 This section draws heavily on Krantz and Kunreuther (2007) where we develop a constructed-choice model for decision making under uncertainty.
cell of the matrix (any given strategy-event combination) is a multi-attribute outcome, composed of all goals that will be achieved if that particular strategy is selected by the decision maker and that particular event happens to occur.

Table 1 depicts aspects of this model in an abstract matrix form and also indicates how the model is used for measurement and decision making. The outcome of the \( i^{th} \) strategy, given that the \( j^{th} \) event occurs, is denoted \( o_{ij} \) (cell entries). This notation does not explicitly show the multiple attributes or multiple goals that comprised a single outcome \( o_{ij} \). In the model, each such outcome is assigned a multi-attribute utility \( u_{ij} \) (Keeney and Raiffa, 1976). Also, each uncertain event is assigned a subjective probability \( p_{j} \). Strategy \( i \) thus has an expected utility given by:

\[
U(\text{strategy } i) = \sum_{j=1}^{n} p_{j} \cdot u_{ij}
\]

The central feature of the model is that people should select a strategy that maximizes \( U \). As shown by Savage (1954), this expected-utility equation serves as the basis for measurement of outcome utilities \( u_{ij} \) and subjective probabilities \( p_{j} \). We refer to this model as subjective expected multi-attribute utility (SEMAUT).
Table 1: General strategy/event structure for decision making under uncertainty

Matrix entries are multi-attribute outcomes for strategy/event combinations

<table>
<thead>
<tr>
<th>Possible Strategies</th>
<th>Possible Events (mutually exclusive and exhaustive)</th>
<th>( E_1 )</th>
<th>( E_2 )</th>
<th>( \ldots )</th>
<th>( E_n )</th>
</tr>
</thead>
<tbody>
<tr>
<td>strategy 1</td>
<td></td>
<td>( o_{11} )</td>
<td>( o_{12} )</td>
<td>( \ldots )</td>
<td>( o_{1n} )</td>
</tr>
<tr>
<td>strategy 2</td>
<td></td>
<td>( o_{21} )</td>
<td>( o_{22} )</td>
<td>( \ldots )</td>
<td>( o_{2n} )</td>
</tr>
<tr>
<td>…</td>
<td></td>
<td>( \ldots )</td>
<td>( \ldots )</td>
<td>( \ldots )</td>
<td>( \ldots )</td>
</tr>
<tr>
<td>strategy m</td>
<td></td>
<td>( o_{m1} )</td>
<td>( o_{m2} )</td>
<td>( \ldots )</td>
<td>( o_{mn} )</td>
</tr>
</tbody>
</table>

Events have subjective probabilities: \( p_j = \text{prob}(E_j) \)
Outcomes have subjective values: \( u_{ij} = \text{value}(o_{ij}) \)

\( u_{ij} \) may be integrated across multiple attributes of \( o_{ij} \)
Multi-attribute utility is integrated across uncertain events
We contrast the matrix in Table 1 with Table 2, which depicts aspects of the plan/goal model in a similar abstract form. Here, the $i^{th}$ plan yields a decision weight $w_{ij}$ (cell entries) for the $j^{th}$ goal, $G_j$. This notation does not, however, explicitly show the contingencies leading to each goal. Each $G_j$ is assigned a value $v_j$.

**Table 2: General plan/goal structure for decision making**

*Matrix entries are decision weights for different goals, conditional on events*

<table>
<thead>
<tr>
<th>Possible plans</th>
<th>Active Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$G_1$</td>
</tr>
<tr>
<td>plan 1</td>
<td>$w_{11}$</td>
</tr>
<tr>
<td>plan 2</td>
<td>$w_{21}$</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>plan m</td>
<td>$w_{m1}$</td>
</tr>
</tbody>
</table>

Goals have subjective values $v_j = v(G_j)$

Plans have decision weights for each goal $w_{ij} = w(G_j | \text{plan } i)$

Plan i is evaluated in terms of the $v_j$ and $w_{ij}$
The goals/plans model can explain differences in crop growing decisions by small Southern farmers in 1860 and 1880 as to how much acreage they would allocate to cotton and corn. One would have a more difficult time explaining this behavior using the standard SEMAUT model.

To illustrate this point, consider the case where the yield from an acre of corn is known with certainty but there is some uncertainty associated with the yield from cotton because the price per bushel might vary. For simplicity, suppose that the cotton price per bushel would be high, average and low with probabilities of .2, .5 and .3 respectively and the farmer is considering adopting one of two plans:

Plan 1: ¾ of his acreage with cotton and ¼ with corn

Plan 2: ¾ of his acreage with corn and ¼ with cotton

The farmer has the three goals stated above:

Goal 1 Obtaining a high financial return,

Goal 2 Having enough food for the family,

Goal 3 Reducing his debt.

For purposes of this example, we will consider a strategy and a plan as having the same meaning.\(^3\) Using an SEMAUT model, one would compare the two plans or strategies by

\(^3\)In non-technical contexts, the words plans and strategies are synonyms. However, strategy already has a technical meaning in game theory, where it refers to a choice element for a game represented in normal (rather than extensive) form. That is, a strategy specifies exactly what the player will do in every circumstance that arises in the course of playing a game. This technical meaning is one that we do not wish to convey in the goals/plans framework. For a more detailed discussion of this point see Krantz and Kunreuther (2007) p. 145.
evaluating each using multi-attribute utility to integrate the three goals for each outcome \(o_{ij}\) in the matrix depicted in Table 1. This is a complex process, involves probing artificial decision situations that are likely to puzzle respondents and inhibits consideration of multiple goals. Preferences are constructed (not revealed) and heterogeneous goals make their construction difficult. The focus is on outcome utilities so one can weight them by probabilities and maximize SEMAUT.

In contrast, the goal/plan framework drops such artificial compounds by eliciting simple goals directly. To highlight this point, Tables 3 and 4 depict the crop-growing decision in 1860 and 1880 using a 2x3 matrix with the two rows reflecting the above two plans and the three rows reflecting the goals of concern to the farmer. In this example, the decision weights \(w_{ij}\) assigned to each goal is determined by the probabilities associated with a high, average or low price of cotton per bushel and its ability to satisfy the particular goal in question.

**Table 3: Plan/goal matrix for small farmer in 1860**

<table>
<thead>
<tr>
<th>Plans</th>
<th>Obtaining a high financial return</th>
<th>Having enough food for the family</th>
<th>Reducing debt</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Plan 1:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grow (\frac{3}{4}) cotton (\frac{1}{4}) corn</td>
<td>(.7)</td>
<td>(.7)</td>
<td>(.7)</td>
</tr>
<tr>
<td><strong>Plan 2:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grow (\frac{1}{4}) cotton (\frac{3}{4}) corn</td>
<td>(.2)</td>
<td>(1)</td>
<td>(1)</td>
</tr>
</tbody>
</table>
As pointed out above, in 1860 small farmers in the South had more acreage and less debt than they did in 1880. They were assumed to have a high financial return (Goal 1) from Plan 1 if the cotton price per bushel was high or average (which occurs with probability .7). By adopting Plan 2 the cotton price per bushel would have to be high (which occurs with probability .2) for them to meet this goal. However, farmers are assumed to be able to satisfy Goals 2 and 3 with certainty by allocating most of their land to corn. Suppose the values associated with these two goals ($v_2$ and $v_3$) were sufficiently high relative to $v_1$ so that a farmer would choose Plan 2 over Plan 1 based on the weights depicted in Table 3.

Now let’s turn to 1880. These same farmers had a better chance of satisfying Goals 2 and 3 by adopting Plan 1 and gambling that the price of cotton would be average or high, in which case they would be able to feed their family and reduce their debts. In fact, only if the cotton price was high (which occurs with probability .2) would they have a chance of meeting these two goals if they allocated only ¼ of their acreage to cotton (Plan 2).

**Table 4: Plan/goal matrix for small farmer in 1880**

<table>
<thead>
<tr>
<th>Plans</th>
<th>Obtaining a high financial return</th>
<th>Having enough food for the family</th>
<th>Reducing debt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan 1:</td>
<td>.7</td>
<td>.7</td>
<td>.7</td>
</tr>
<tr>
<td>Grow ¾ cotton</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>¼ corn</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plan 2:</td>
<td>.2</td>
<td>.2</td>
<td>.2</td>
</tr>
<tr>
<td>Grow ¾ corn</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>¼ cotton</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. Policy Implications

The goal/plans model of decision making implies that individuals’ actions will be driven by certain goals that satisfy their immediate needs. In some cases these choices may not be as desirable as others in the long-run. For example, the challenges in getting farmers to adopt new technologies are often constrained by a desire to maintain the status quo because of a concern that if one changed plans, there would be less likelihood of being able to satisfy short-run goals such as feeding one’s family.

A classical example of this behavior was demonstrated by peasant farmers in the community of Nealtican, Mexico, who were reluctant to adopt a high-yield hybrid maize developed by Norman Borlaug as part of the Green Revolution. Maize and beans, the basic subsistence crops, are consumed in some form at almost every meal. Generally, no other crops are cultivated for the purpose of domestic human consumption. Maize is the most important crop, and three different varieties were grown for human consumption. White maize was sown first. If it didn’t sprout then blue maize was sown, followed by red maize if the blue had not sprouted. In other words, multi-colored maize served as a form of crop insurance. The hybrid maize developed by Borlaug required the same length growing season as the three varieties of the conventional maize. A single failure of the hybrid maize would have left the farmers without their life-sustaining crop with no time to plant the conventional varieties.

To counteract the concern by subsistence farmers that they would not achieve their subsistence level of food with a new crop, Clifton Wharton, Jr. proposed that the peasants who innovate be assured that if output fell below minimum subsistence levels they would not suffer (Wharton, 1971). One way to do this is to guarantee that farmers obtain at least the same return
as with their existing crop if they switched to the higher yield seed. In other words, the Mexican government would provide them with an insurance policy so that their short-run goals would be met. This plan apparently induced most subsistence farmers in the country to switch to the high-yield crop.⁴

On a broader level, the high variance associated with investment in certain activities may discourage low-income individuals from taking action that will improve their welfare in the long-run. In the case of low-income farmers, another way of reducing the variance in the crop allocation decision would be for the government to provide financial credit at market or subsidized rates of interest following poor harvests. Lending institutions, such as the Grameen Bank in Asia, are currently taking steps to encourage low-income residents to adopt innovations by providing credit without any collateral to the poorest of the poor in rural Bangladesh. These individuals would otherwise be forced to obtain high-interest loans from local moneylenders and might be required to have part of their land as collateral should they be unable to repay the loans in a timely period.⁵

Gavin Wright may be able to provide some insights from the perspective of an economic historian as to strategies that have been successful in dealing with safety-first decision-making in contexts other than farming. He might also shed light on when and why other programs have not worked well in practice. I look forward to interacting with him and others on these issues that were initiated on the tennis courts of Yale University over 35 years ago.

---

⁴ In the case of Nealtican farmers, many decided not to switch to the high yield maize for other reasons such as its disagreeable taste and texture. For an insightful discussion as to why peasants in the community rejected the Green Revolution see Clawson and Hoy (1979).

⁵ For more details on the current activities of the Grameen Bank go to http://www.grameen-info.org/
References


